1943, No. 1 March 31

COPEIA

Established in 1913

Published By
The American Society of Ichthyologists
and Herpetologists

Copeia *1943, No. 1* *March 31*

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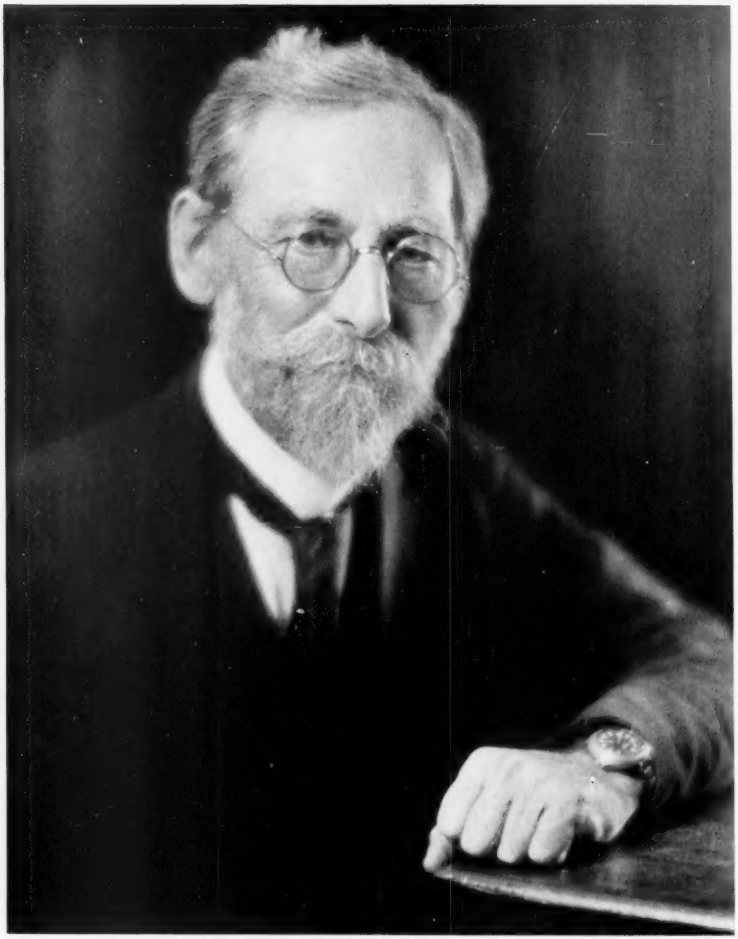
Published quarterly by the American Society of Ichthyologists and Herpetologists, at the Museum of Zoology, University of Michigan, Ann Arbor, Michigan, under the Act of August 24, 1912. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized February 11, 1924.



Leonhard Stejneger.

LEONHARD STEJNEGER*

"DON'T ever hesitate to be inconsistent. Consider every case on its individual merits. To incline towards being consistent is to show signs of a closing mind." These are something very like the remarks, but by no means the only remarks, which Leonhard Stejneger addressed to a certain youngster of sixteen years who planned a monograph of the African chamaeleons and who went to Washington to see the National Collection. There is no need to say that the monograph never appeared and that the callow youth grew, greatly in size and in the appreciation of his own limitations, and the warm affection which began that day increased steadily for forty years. Stejneger had that quality that erases the barrier of years and that puts in its place a serene feeling of contemporaneity. This is a rare and subtle essence, which perforce must emanate, when it exists at all, from the elder of a pair of friends. Not to sacrifice the assurance that age justifies and still less to show no trace of condescension and perhaps most a willingness to listen generously, and forever to be patient, are the other great qualities that bring about an easy companionship, one in which difference of age seems to vanish. So now one of his younger friends renders a loving, if wholly inadequate, tribute to the qualities which made Leonhard Stejneger an inspiring figure in American Science.

Diversity of interests and of talents were in him extraordinarily combined. Being an antiquarian, a classicist, a rarely accomplished linguist and a naturalist in the widest sense, he possessed a foundation on which with good health and great industry he built a mighty structure of rarely excellent work.

He cast a beneficent shadow across the face of American Natural History which will rest there for all time.

THOMAS BARBOUR

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* As we go to press the sad news has reached us of DR. LEONHARD STEJNEGER'S death on February 28, at the age of 91. With Dr. Barbour's permission we are reprinting above, with a few modifications, the tribute to Dr. Stejneger which appeared in the *Leonhard Stejneger Anniversary Number* of COPEIA, honoring him on his eightieth birthday, October 30, 1931. We quote from Dr. Barbour's letter:

"Leonhard Stejneger has gone and left but the shadow of his great name. He was the knightly heir of a hardy and virile race, a viking in the great tradition. Words are inadequate to set forth his magnificent record of achievement, the simplicity of his character, the versatility of his great mind. All of us recognize that he was a herpetologist without a peer and that we will never see his like again."

The portrait was loaned by Dr. Doris Cochran.

An Intergradient Population Connecting *Anniella pulchra pulchra* and *Anniella pulchra nigra*

By Charles M. Miller

THE Monterey Peninsula, on the coast of Monterey County, California, is the source of most typical specimens of *Anniella pulchra nigra*. These limbless lizards range over the entire peninsula, but are more common in the coastal sand dunes. Coastal sand dunes extend north from the city of Monterey along the shore of Monterey Bay to within one mile of Capitola on the northern arm of the bay (see Fig. 1), the limbless lizards range north in these dunes to Watsonville. An intergradient population occurs in the dunes near the mouth of the Salinas River north of the Monterey Peninsula. The relationship between this population and those of true *A. p. pulchra* and *A. p. nigra* is herein analyzed on the basis of the composite dorsal coloration of living lizards, the ratio of tail length to total length, and the degree of anomalous fusion of head plates.

I wish to express my appreciation to Dr. Alden H. Miller of the Museum of Vertebrate Zoology for suggestions and criticisms and for the use of specimens in the Museum, and to Mr. Joseph R. Slevin for the use of the collections of the California Academy of Sciences. The live lizards used in color determinations were collected by the author and are now in the collection of the Museum of Vertebrate Zoology. The color determinations were made by a window with a north light on a clear day; colors in Ridgway's nomenclature are distinguished by capitalization.

J. G. Fischer (1885: 9) described *Anniella nigra* from a black individual that was sent to him by J. Behrens. Accompanying the black lizard was a specimen of *Anniella pulchra*. Both lizards were said to have been collected in "San Diego, California." *Anniella pulchra pulchra* is common at San Diego, but this locality is approximately 300 miles south of the present known range of *A. p. nigra*. The black lizard was probably mislabeled, as the only locality known where black individuals have been taken is the Monterey Peninsula.

Specimens of the limbless lizard taken at Morro and at Pismo Beach, San Luis Obispo County, are regarded as intergrades between *A. p. pulchra* and *A. p. nigra* (Grinnell and Camp, 1917: 170; Klauber, 1940: 16); they show longitudinal lines like the younger individuals from Monterey. Fischer does not mention longitudinal lines in his description, which contains an excellent account of the coloration.

The dorsal color of *Anniella p. nigra* varies from silvery drab in the young lizards through silver brown (Hair Brown), light brown (Chaetura Drab), and dark brown (Chaetura Black) to black in the large adults. The ventral surface varies from Wood Brown in the young individuals, through Pinkish Olive and Olive Lake, to Pyrite Yellow and Sulphine Yellow of young adults, to yellower than Lemon Chrome in old adults.

The young have two or three lateral stripes on each side of the body and one fairly well defined dorsal stripe along the middorsal line. As the lizards become older, the dorsal stripe becomes less distinct. It is completely lost

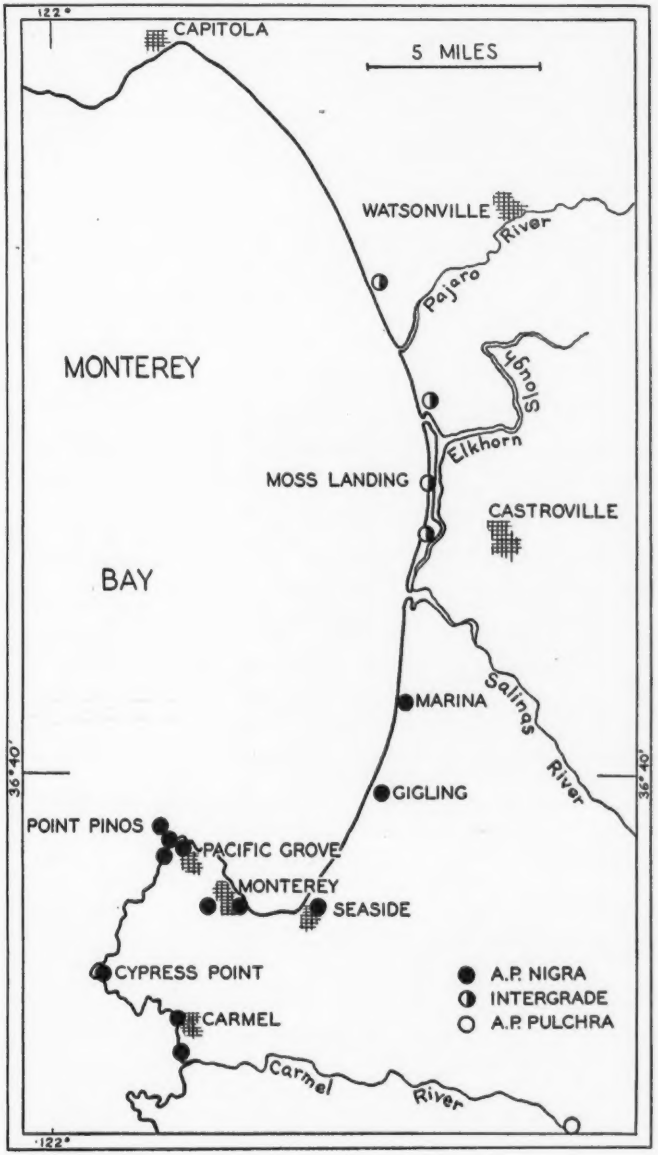

Fig. 1. Locality records of *Anniella p. pulchra, A. p. nigra,* and intergrades in the vicinity of Monterey Bay, California.

in some fairly light individuals but is retained prominently in some dark ones. Also with the increase in age the lateral stripes become reduced to one or two and the dorsal coloration darkens. The largest, blackest adults have no trace of dorsal or lateral stripes.

The largest, blackest living *A. p. nigra* at hand is 160 mm. from snout to vent. The composite color of the dorsum is darker than Aniline Black. The skin between scales is Pale Purplish Gray. The individual dorsal scales are black, with fine gold spots. The venter is slightly yellower than Lemon Chrome. The color of the chin is similar to that of the dorsum. The scales anterior to the vent are Dark Slate Violet, whereas the skin between scales is Pale Purple Gray. The tail is broken and the regenerated tip is black.

A large living *A. p. pulchra,* from Antioch, Contra Costa County, is silver drab dorsally. There is one well defined black stripe along the middorsal line and three lateral black stripes on the margins of scale rows 5, 6, and 7. Ventral to the third lateral stripe the scales are Pyrite Yellow, with fine black or brown lines between the scale rows. The sides of the head, chin and throat are Dark Slate Purple, with silver speckles (Mineral Gray) in the centers of the scales. The scales anterior to the vent have Pale Purple Drab centers and Dark Slate Purple margins. The regenerated portion of the tail is black.

A series of 49 live *A. p. nigra* from Monterey Peninsula were segregated by dorsal coloration into five groups:

Silver drab	(Drab)
Silver brown	(Hair Brown)
Light brown	(Chaetura Drab)
Dark brown	(Chaetura Black)
Black	(darker than Aniline Black)

The color of *A. p. nigra* changes with the age of the individual. The smaller lizards are silver drab whereas the larger are dark brown to black. Individuals of *A. p. pulchra* remain approximately the same color throughout their lives; this color is usually silver drab.

The range of snout-vent length in millimeters in different color groups of *Anniella* is shown below. Because of the high frequency of damaged tails, the snout-vent length is used to designate size and thus age.

RANGE OF SNOUT-VENT LENGTH IN DIFFERENT COLOR GROUPS OF *Anniella*

	A. p. nigra		Intergrades		*A. p. pulchra*		Status doubtful	
	no.	length	no.	length	no.	length	no.	length
Silvery wood brown	–	–	–	–	2	94– 98	–	–
Silver drab	5	68– 92	10	89–140	4	121–139	1	81
Silver green	–	–	9	125–163	–	–	–	–
Silver brown	3	121–134	4	118–163	1	116	–	–
Light brown	12	121–144	2	132–133	–	–	1	155
Dark brown	14	127–158	–	–	–	–	–	–
Black	10	149–162	–	–	–	–	–	–

Van Denburgh (1905) obtained similar results with a series of 48 live specimens of *A. p. nigra* from the Monterey Peninsula. He separated his lizards into ten color groups and found that the snout-vent length increases variably as the color darkens. Fisher (1934: 47) showed the same general

correlation, although she did not group her lizards except as "immature" and "mature." Her series of 16 live *A. p. nigra* also were collected on the Monterey Peninsula.

The lizards of the intergradient population fall into some of the same color groups as *A. p. nigra*, but there is one additional group represented. This new group is silver green, and is characterized especially by Deep Grayish Olive and Dark Grayish Olive. It is similar in darkness to the silver brown and light brown groups, but the color is based on a different spectrum color (Lemon Chrome).

Since *A. p. pulchra* is silvery throughout life, it would be expected that intergrades between *A. p. pulchra* and *nigra* would be silvery when adult but at the same time darker than *A. p. pulchra* and lighter than *nigra*. This population fulfills these expectations and this is the major reason for designating it as intergradient.

The intergradient population in the sand dunes 2 miles west of Castroville shows three shades of darkness (see below). Of the intergrades examined 45 per cent were silver drab; 32 per cent were silver drab darkened with 45 per cent black, i.e., Hair Brown; and 23 per cent were Chaetura Black (silver drab darkened with 70 per cent black). The two individuals from Moss Landing were Hair Brown and Chaetura Black, respectively, while the lizard from just north of Elkhorn Slough was Hair Brown. The Watsonville lizard was Chaetura Black. The individuals from Castroville, Moss Landing and Elkhorn Slough are from the intergradient population. The Watsonville population cannot be definitely allocated as *p. nigra* or intergradient until more material is at hand. The specimen from Marina was too small to show intergradient characters.

SNOUT-VENT LENGTH AND COLOR SHADE OF *Anniella* FROM LOCALITIES ALONG THE SHORE OF MONTEREY BAY

	Not darkened with black		45 per cent black		70 per cent black		87 per cent black		More than 87 per cent black	
	no.	length	no.	length	no.	length	no.	length	no.	length
Watsonville	–	–	–	–	1	155	–	–	–	–
Elkhorn Slough	–	–	1	163	–	–	–	–	–	–
Moss Landing	–	–	1	155	1	163	–	–	–	–
Castroville	10	89–140	7	118–141	5	125–149	–	–	–	–
Marina	1	81	–	–	–	–	–	–	–	–
Monterey	–	–	–	–	1	134	1	138	–	–
Point Pinos	3	68– 78	2	121–129	10	121–144	10	139–158	9	152–162
Carmel	2	90– 92	1	134	1	139	3	127–154	1	149

The typically black adult population of *A. p. nigra* is found from Carmel to Monterey on the Monterey Peninsula. The intergradient population occurs 20 miles to the north near the mouth of the Salinas River and Elkhorn Slough. This population may extend as far north as Watsonville.

Anniella p. pulchra has been reported at San Ardo, Monterey County, approximately 75 miles from Monterey Bay on the upper Salinas River. In all probability it occurs closer to the coast along the river. There may be sufficient dispersal of *A. p. pulchra* down the river to keep the coastal population quite silvery.

Since *A. p. pulchra* has been reported in the Carmel Valley, 12 miles east of Carmel and again in the upper drainages of the Carmel River at the

Hastings Natural History Reservation, it might be expected that the coastal population of lizards at the mouth of the Carmel River would be of a silvery intergradient character. This is not so, however, as the lizards at Carmel are typically black *A. p. nigra*.

The ratio of tail length to the total length in the intergrades is intermediate between that of *A. p. pulchra* and *A. p. nigra* as shown below. Only unbroken tails are considered in figuring this ratio, as regrown tails are only a fraction of their original length. Regrown tails are marked by a black tip and a disruption of the scutellation.

RATIO OF TAIL LENGTH TO TOTAL LENGTH IN *Anniella*

	Number	Average	Extremes
A. p. nigra	53	.317	.256–.365
Intergrades	10	.342	.328–.390
A. p. pulchra	20	.373	.318–.424

A. p. nigra is more variable in the fusion of head plates than is *A. p. pulchra*. The plates most commonly involved are the first and second preoculars, adjacent supralabials, and the interparietals and frontoparietals. The intergradient population is closer to *A. p. pulchra* than to *nigra* in this character, being practically devoid of any anomalous fusions. Of the 23 lizards examined, only one showed the fusion of the first and second preoculars and this was on one side only. There were two other anomalies, neither of which has appeared in *A. p. pulchra* or in *nigra*. One is the fusion of the two median parietals with the interoccipital between them, thus forming a short wide scale across the back of the head; the other is the division of the frontal in the middorsal line to form a pair of plates.

PERCENTAGE OF ANOMALOUS FUSION OF HEAD PLATES IN *Anniella*

	94 *A. p. nigra*	23 Intergrades	72 *A. p. pulchra*
preoculars	14.9	4.3	6.6
supralabials	48.9	none	none
inter- and frontoparietals	20.6	none	none

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MUSEUM OF VERTEBRATE ZOOLOGY, BERKELEY, CALIFORNIA.

Hermaphroditism in a Turtle of the Genus *Pseudemys*

By Ira B. Hansen

A MATURE hermaphroditic turtle, a specimen of the common *Pseudemys troostii*, was discovered during the course of routine laboratory dissections. Fortunately the animal was diagnosed as peculiar when found and saved from destruction. Such individuals among turtles are sufficiently rare to warrant a description of the anatomical features involved. Risley (1941) recently reviewed the literature on hermaphroditism in turtles, pointing out the apparent rarity of this condition and describing two additional cases.

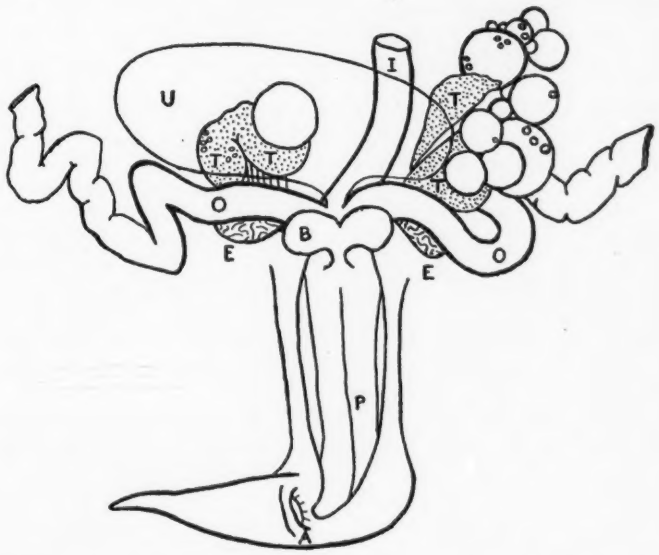

Fig. 1. Ventral view of the genital system of a hermaphroditic turtle. A, Anus; B, Bulb of corpora cavernosa; E, Epididymis; I, Intestine; O, Oviduct; P, Penis; T, Testicular portion of ovotestis; U, Urinary bladder drawn as if transparent.

The external characters of this specimen are those of a male. The sexes are easily distinguishable in this species on the basis of the claws on the front feet. In the female these are short and stocky and are built primarily for strength in digging. In the male the claws are elongate and narrow, in striking contrast to those of the female. It was anticipated, therefore, that the normal male genital system would be encountered. Investigation of the viscera disclosed distinct paired ovaries containing large, yolk-filled eggs, and

paired, normal oviducts in the stage of enlargement corresponding to the degree of development of the ovary. Closer examination showed, however, that each gonad was not completely ovarian but an ovotestis. The epididymis, vas deferens and penis were also present.

The left ovotestis is the larger of the two both in ovarian material and testicular tissue. About four-fifths of its volume is ovary, enlarged by the presence of one fully developed ovarian egg which is about 17 mm. in diameter, and eight smaller eggs varying in size down to 6 mm. in diameter. Besides these there are a large number of very small eggs that are still white or yellow, that presumably would not have matured for the approaching breeding season. The testicular portion is divided into two lobes, one medial to the cranial end of the ovarian stroma, and the other posterio-medial to the caudal end of the ovarian tissue. Neither testicular mass assumes the shape of a normal testis but each is compact and shows definite seminiferous tubules visible through the covering membrane. The whole ovotestis is held by what would normally have been the mesovarium in the same relation as found in the normal female.

The right ovotestis was partially destroyed in earlier dissections, but the whole testicular portion and a part of the ovarian tissue remained intact. There is evidence that at least one mature egg was ready for ovulation, and presumably the condition of the other ovarian tissue was similar to that of the left side. The testicular tissue on the right, however, is in a single, thick, inverted U-shaped piece, the cranial end of which flared out to form a cup around the mature egg. Seminiferous tubules are distinctly visible throughout, but it is interesting to note that scattered over the surface of the testis there are a large number of very small oocytes. These show a tendency to cluster laterally and anteriorly to the testicular mass. The testis is bent in such a fashion that the morphologically anterior end is actually pointing posteriorly.

Each testicular mass has several distinct vasa efferentia passing posteriomedially from it through the mesentery and uniting in a well formed epididymal body. In the left bilobed testicular mass, each lobe has its own vasa efferentia although they both use the same left epididymal body. The coiled tube of the body is somewhat smaller in diameter than in a normal male, but it gives evidence of being functional and is connected as closely to the testicular body as usual. Each epididymis is located in the mesentery between the gonad and the oviduct and lies posterior to the gonad and dorsal to the oviduct. Each connects through a vas deferens running medially to the cloaca. These entrances lie just dorsal to and at the base of the penis in the normal relation to the ureters. The vasa deferentia enter immediately posterior to the oviducts and anterior to the ureters.

Both oviducts are normal. They extend laterally from the cloaca in an enlarged portion that is deeply pigmented. Distally they lose the pigment and the heavy walls become convoluted, flattened and situated dorsad of the gonad. Each has an open ostium at the border of the mesotubarium. Both the mesovarium and the mesotubarium unite as usual before attaching to the dorsal body wall. The oviducts are in every respect normal and appear to be functional.

The penis is well developed and is entirely normal, with paired corpora cavernosa, a distinct mid-ventral urethral groove, and a glans at its distal end. Likewise, the paired bulba of the corpora cavernosa are enlarged and in their normal relation to the base of the penis and the entrance from the bladder. The penis is in its proper size ratio for the length of the cloaca and certainly appears to be functional. This is supported by the well developed ventral musculature.

It is likely from the condition of the genital organs that this turtle could perform as a male, and could lay eggs as a female. Whether it would receive another male is questionable but possible. At any rate there is no doubt that the ovary is functional, and that eggs were laid, presumably with shells. There are three lines of evidence to support the latter contention: there are no signs of abdominal retention of eggs; the oviducts are open and enlarged; and investigation of the interior of the proximal end of the oviduct yielded a small hard calcareous mass indicating that the oviduct had the ability to produce an egg shell. It is likewise evident that the testicular portions are functional, not only from their apparent healthy condition but from the abundant sperm recovered from a smear of the contents of the epididymis. Both epididymal bodies contain a white mass of sperm.

It is interesting that it is the morphologically posterior part of the gonad that has become the testis, and that in the right ovotestis the distinction between cortex as ovary and the medulla as testis is still shown by the distribution of immature eggs on the surface. Risley has shown in the musk turtle that a long period of hermaphroditism exists embryologically, with the cortex differentiated in both sexes. Even males at the time of hatching may have oocytes of considerable size in the cortex. These and the cortex normally regress rapidly. It is highly probable, therefore, that in this specimen of *Pseudemys troostii* the embryology of the genital organs is somewhat similar and the embryological hermaphroditism has persisted into the adult. A late sex reversal may have been in progress, but the probability is that the individual was born hermaphroditic. This is supported by the complete connecting ducts and their normal relationships for both the ovarian and testicular portions of the ovotestis.

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Department of Zoology, The George Washington University, Washington, D. C.

On a Collection of Reptiles from Palestine, Transjordan, and Sinai [1]

By Georg Haas

THE following paper deals with reptiles collected on an excursion through Transjordan, southern Palestine and Sinai, from March 26 to April 4, 1936, by Dr. O. Theodor and the writer, of the Hebrew University, and Mr. H. Mendelssohn of Tel Aviv. Although our route was the ordinary one to Petra, the number of forms obtained was rather remarkable. In addition to new localities for well-known types, rare forms were taken. *Tropiocolotes steudneri* and *Leptotyphlops philippsi* were hitherto unknown from Palestine.

Our party went from Jerusalem to Amman via Jericho. From Amman we turned south, following the Hedjaz Railway via Sisah, Katrane and Hissah, to Ma'an. From Ma'an we went to Wadi Mussah, Petra and back to Ma'an. Leaving Ma'an again we followed the road to Akaba, passing through Guweira Police Station and through Wadi Jtm. We spent two days in Akaba collecting marine animals in the coral reefs. From Akaba we went north via Umm El Rashrash where we entered Egyptian territory to Ras el Nakb, El Kuntiala, Khosseima, and Auja el Khafir. From Beersheba we drove eastward for 30 kilometers, returned to Beersheba, and from there to Jerusalem.

Geological formations were seen that are rare or absent in northern Palestine, such as the rocks and sandy deserts of Nubian sandstone (Petra, Plain or Guweira): the "Hammadas," which are plains of white dusty soil covered with very coarse gravel of basalt or black flint between Hissah and Ma'an; and the primitive rocks typical of the Sinai Mountains, with an extremely impoverished fauna and flora. This latter formation extends from the southern border of the Guweira plain nearly to the summit of the Sinai desert plateau (in Ras el Nakb) interrupted only by a strip of sandy desert, the Wadi Araba. There are also desert plains and steppes with more vegetation like those of Palestine, where the predominant plants are *Anabasis, Suaeda, Haloxylon* and other Chenopodiaceae. We found such regions in the Wadi Araba and from El Kuntilla to 40 km. south of Beersheba. Long stretches of desert between Sisah and Ma'an consist of clay, interrupted by flint covered hammadas. Near Amman and east of Petra there are areas of *terra rossa* with almost Mediterranean vegetation, as in the Judaean hills. South and east of Beersheba are large areas of clay steppe on which some barley is grown. Wadis always have a much richer flora of more mesophytic character, and species were found in them quite unusual for the general environment. *Ophiops elegans,* for example, was found in a wadi running through a desert plain with its characteristic reptile fauna (*Agama ruderata pallida* and *Eremias brevirostris*).

The list of species obtained by our party follows.

Stenodactylus elegans Anderson.—Two male specimens, south of Hissah, one from flint gravel covered desert, one from under stone in a wadi. March 28, 1936.

1 I wish to thank Dr. Otto Wettstein of the Museum of Natural History, Vienna, who kindly permitted me to work in his department in past years, for his advice in a number of identifications. I am also obliged to Dr. O. Theodor and Mr. H. Mendelssohn for putting at my disposal the material they caught during this excursion.

These two specimens are remarkable for their small size, their stout habitus, and their unusually large and short heads. They appear to be distinguished from Palestinian specimens by their relatively short tail, with an abrupt slender base and bulb-like swellings of the hemipenes at its root. Supralabials 10-10. The larger specimen measures 38 mm., compared with 48 mm. for a male specimen from Tel Aviv.

Pristurus flavipunctatus ***guweirensis,*** subsp. nov.—Two male and two female specimens from the northern border of the Nubian sandstone desert of Guweira, between Ma'an and Guweira Police Station, March 30, 1936, on sandstone rocks. Co-types in Naturhistorisches Museum, Vienna.

DESCRIPTION.—Distinct interrupted longitudinal short lines of rusty color on the back; ground color greyish brown with brighter spots and a lighter area along the mid-dorsal line. Several small rusty patches on the back; sides of head marbled with black, some isolated head scales dark; under surface of the head and the gular region with black undulating transverse lines form the continuation of the spots on the sides of the head; upper and lower labials with black punctate spots; ventral surface yellowish white with two indistinct series of small black spots on each side. Supralabials 6-6.

MEASUREMENTS.—Snout to vent, 26 mm., tail 30.5 mm.

REMARKS.—Our specimens closely resemble *P. rupestris,* and as *P. flavipunctatus* and *P. rupestris* differ only in minor details I propose, on the advice of Dr. Wettstein, to unite the three forms as subspecies of *P. flavipunctatus,* i.e., *P. flavipunctatus flavipunctatus, P. f. rupestris,* and *P. f. guweirensis. P. f. guweirensis* is considerably smaller than the other two; and the serrated ridge on the tail is much less developed. The black marbled pattern of the gular region is characteristic of *P. f. guweirensis.* The new form is at the northwestern limit of the range of the genus.

Hemidactylus turcicus Linnaeus.—Three specimens, two from the Pass between Sisah and Katrane, 70 km. south of Amman (March 27, 1936) (several others seen); and one from a wadi, south of Hissah.

Ptyodactylus hasselquistii guttatus Heyden.—One specimen, on Nubian sandstone rocks on the southern border of the Guweira plain, March 31, 1936. This specimen had the reddish yellow coloration of the substratum. It belongs to Anderson's group "Phalanx guttata, nostril swollen." This rock-inhabiting gecko is abundant in Palestine, especially in the hills near Jerusalem and in the Jordan Valley.

The specimen measures 62.5 mm. from snout to vent, tail 53.5 mm.; there are 9 lamellae under the third finger and toe.

Tropiocolotes steudneri Peters.—Four specimens, two from the steep slopes above Ain Teshka, two from Wadi Ohar, on the western border of the Dead Sea. This gecko is new to Palestine, known hitherto only from Cyrenaica, Egypt, Nubia, and Sinai. Our specimens were found under single big stones or among rubble on the hill sides.

Agama mutabilis sinaita Heyden.—Two specimens south of Guweira, March 31, 1936. This rock-inhabiting agama lives in the hottest parts of Palestine, i.e. in narrow wadis on the western border of the Dead Sea and from there to the south (on the slopes of the Dead Sea above Ain Feshkha and Ain Gedi).

Measurements of a large male from Guweira, snout to vent 94 mm., tail 178 mm.

Agama ruderata pallida Reuss.—Eleven specimens; eight from between Ma'an and Hissah, Transjordan (March 28, 1936), one from 40 km. south of Beersheba; one from 31 km. north of Akaba, toward El Kuntilla, and one 35 km. north of Akaba.

I follow Wettstein in placing *pallida* as a subspecies of *Agama ruderata* (Wettstein, 1928: 775).

These specimens are rather uniform in size and habitus. All the smaller dorsal scales perfectly smooth; head often bluish, tail with black crossbands; a black cloudy dorsal pattern on yellowish white ground; in a few specimens there are darker longitudinal streaks on the gular region; rapid and remarkable color changes take place in this species.

The largest male specimen, from between Hissah and Ma'an, measures 96 mm. from snout to vent, tail 113 mm. The largest female, from the same locality, measures 92 and 98 mm. Six male specimens average 84 mm. in length of head and body, while the five females average 78 mm. The tail is relatively longer in males.

Agama ruderata ruderata Olivier.—Three specimens; one from 12-15 km. south of Amman; one from about 15 km. east of Beersheba, and one between Hissah and Amman.

A. r. pallida and *A. r. ruderata* are completely absent in the Judaean *terra rossa* hills; in the coastal plain their northern limit may lie between Gazal and Jaffa. In the coastal plain the only agama found north of Jaffa is *A. stellio*. *A. r. ruderata* occurs much more to the north in Transjordan and Syria than in Palestine. We found no specimens in the Jordan Valley or in the Judaean desert as far south as Wadi Ghar.

The male specimen, from Amman, measures 58 mm. from snout to vent, tail 85 mm.; the larger female, from east of Beersheba, measures 70 and 72 mm.

Agama stellio stellio Linnaeus.—Two specimens; one from the Canyon of Petra; one from Wadi Mussah. These specimens with others seen near Amman and east of Beersheba occurred near cultivated land, with a flora of a rather Mediterranean character.

This species is very common in Palestine, but is absent in real desert and in the dunes along the seashore. As a follower of human cultivation, it may also penetrate such regions after human activity has enriched the flora and created suitable hiding places. The food of this species consists to a great extent of large ants (*Messor* and others). Specimens from Transjordan have the orange dots on the back brighter than in specimens from Palestine.

Lacerta laevis Gray.—Three specimens; Canyon of Petra, March 29, 1936.

The rich color pattern of these specimens differs considerably from that of Palestinian ones. The scales are very feebly keeled. Dr. Wettstein, who carefully examined these specimens, believes that they may prove to be referable to a distinct local race. The specimens are all males, the largest measuring 55 mm. from snout to vent, tail 108 mm. (regenerated).

Acanthodactylus tristrami Günther.—Three specimens; two 15 km. south of Amman; one from between Sisah and Hissah. March 26, 1936.

These localities are more southern than the range of this species hitherto known. The subocular borders the mouth; in the female specimen from between Sisah and Hissah the first supraocular is divided into two shields; in the two males from Amman it is broken up into small granules.

The largest male measures 92 mm. from snout to vent, tail 137 mm.; the female specimen measures 71 + 86 mm.

Acanthodactylus pardalis pardalis Lichtenstein.—Six specimens; five from 20 to 30 km. east of Beersheba, en route to Kurnub (April 2, 1936); one from 36 km. south of Amman (March 27, 1936).

This is the predominant species of *Acanthodactylus* in the semi-desert clay region of the Beersheba district. The species is certainly absent in the Jordan Valley and in the surrounding deserts, in the Judaean hills, and in the coastal plain between Acre and Jaffa.

The largest male measures 75 and 93 mm.; the larger female 71 and 94 mm.

The single specimen from south of Amman measures 87-118 mm.; femoral pores 19-19; three supraoculars; subocular bordering the mouth; twelve longitudinal series of ventral plates; fourth toe very feebly pectinated externally; head very much flatter than in specimens from Beersheba. This specimen, differing from *pardalis pardalis* in its flatter head and longer, whip-like tail, may well represent a distinct race.

Acanthodactylus boskianus asper Audouin.—Ten specimens; two from south of Beersheba (April 3, 1936); one from between Khosseima and Anja El Khaffir (April 3, 1936); two from between Ma'an and Guweira (March 30, 1936); one from Wadi Mussa (March 29, 1936); one from between Hissah and Ma'an (March 27, 1936); one from Khosseima (April 2, 1936); two from between Sisah and Katrane (March 28, 1936); one from between Sisah and Ma'an.

These specimens show so great an amount of variation in both scale characters and coloration that it is evident that the current partition of this widespread species into subspecies is far from satisfactory, and that a large collection would repay detailed study. Our specimen from between Sisah and Ma'an, Transjordan, a male with 46 dorsal scales at mid-body, differs most from the rest of the series, and suggests that a form may exist in that region bridging the gap between *A. boskianus asper* and *A. schreiberi syriacus*.

It is absent in the coastal plain north of Rehoboth as well as in the Judaean *terra rossa* territory. In the coastal plain north of Rehoboth it is replaced by *Acanthodactylus schreiberi syriacus*.

Acanthodactylus scutellatus scutellatus Audouin.—Three specimens, all from 40-45 km. south of Beersheba, April 3, 1936. This species, a typical and exclusive inhabitant of sandy dunes in the coastal plain, was not found in Transjordan, and appeared only on the loose sandy soil between Khosseimah and Beersheba. In Palestine, *A. scutellatus* ranges to a point a little north of Tel Aviv.

Acanthodactylus grandis Boulenger.—Two specimens, between Hissah and Ma'an, in stony desert, March 28, 1936. This is the most southern locality record for this species. Color pattern very faint; two indistinct rows of black spots on each side; bright patches on the nape, on grayish brown

ground. The larger specimen measures 81.5 from snout to vent; tail 144.5 mm.

Acanthodactylus robustus Werner.—One specimen, west of Ma'an, in desert, March 29, 1936. The present specimen differs from the original description in that the subocular broadly borders the lip behind the fourth supralabial; dorsal scales smooth; ventral scutes in 29 transverse and 12 longitudinal rows; dorsal scales of the middle part of the tail obtusely keeled. Length from snout to vent 67 mm., tail (regenerated) 62.5 mm.

Ophisops elegans elegans Ménétries.—Eight specimens, five between Petra and Ma'an, March 29, 1936; one between Amman and Hissah, March 27, 1936; one from Wadi Mussah, March 29; one between Ma'an and Guweirah, March 30.

Eremias brevirostris Blanford.—Thirteen specimens; six from between Amman and Hissah, seven from between Hissah and Ma'an. There are considerable differences in size and coloration between these two lots, which should be compared with specimens from Iraq.

Eremias guttulata guttulata Lichtenstein.—Eighteen specimens; three from Sisah to Hissah, March 26; four from pass between Sisah and Katrane, 70 km. south of Amman, March 27; two from lower Mussah near Petra, March 29; two from between Ma'an and Guweira, March 30; two from between Guweira and Akaba, March 31; four from south of Beersheba, April 3.

Eumeces schneideri pavimentatus Geoffroy.—Two specimens, from 10 to 15 km. south of Amman, March 26, 1936.

Scincus scincus Linnaeus.—One specimen; northern end of the sandy Guweira desert plain in the Nubian sandstone area, March 30, 1936.

The dark crossbands of this species are not yet developed in this specimen, although specimens of the same size from Egypt show them clearly. Our specimen considerably extends the range to the northeast. The specimen measures 50 mm. from snout to vent, tail 34.5 mm.

Chalcides ocellatus Forskål.—Four specimens; one from pass between Sisah and Katrane, March 27, 1936; three from 30 km. east of Beersheba, April 2-3, 1936.

This species is distributed throughout Palestine, in the hills as well as in the coastal plain; it is found in abundance in the dunes bordering the seashore.

Typhlops simonii Boettger.—One specimen from 30 km. east of Beersheba, on clay soil, April 3, taken under a stone. Total length 180 mm.; maximum diameter 2 mm.

We have a large specimen of this species from Tiberias, and a smaller one from east of Beni Naim, between the Dead Sea and Hebron.

Leptotyphlops philippsi Barbour.—One specimen from Emek Jesreel (Plain of Esdraelon), Ain Harod, April, 1935.

Eirenis coronella coronella Schlegel.—Eleven specimens; eight from between Sisah and Ma'an; one from between Khosseima and Beersheba; one from 30 km. south of Beersheba; and one from 30 km. east of Beersheba on the way to Kurnub. All from typical desert areas, under stones. These specimens have 15 rows of scales around the body; anal divided; ventrals 131 to 154; caudals 37 to 54. There is considerable variation in coloration, but most of the specimens exhibit the cross-banded coloration regarded as characteristic of this species by Schmidt (1939: 78).

Psammophis sibilans schokari Forskål.—Two specimens, one from south of Guweira, March 31.

Tarbophis nigriceps Ahl.—One specimen, about 10 km. south of Amman, March 26.

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Sperm Storage and Copulatory Adjustment in the Prairie Rattlesnake[1]

By Marion Ludwig and Hermann Rahn

THE phenomenon of delayed fertilization in snakes has recently received attention from various sources. The available evidence (see Rahn, 1942) seems to indicate that in several species summer and fall copulations are probably much more common than has hitherto been realized. The spermatozoa remain viable in the oviduct all winter, and are capable of fertilization during the succeeding spring. These circumstances raise many questions concerning the mechanisms of sperm storage in the female, which permit fertilization many months after insemination.

Particular attention was focused on this problem by speculation regarding the function of the rather large vaginal pouches in the prairie rattlesnake, *Crotalus viridis viridis* Rafinesque. The mature females of this species may be classified in two categories: the "post-partum" and "ripe" females. The former have small ovaries and have given birth to young the previous fall, while the latter have large ovaries and have not had young. Spermatozoa are found in the "ripe" females only, and are confined to the posterior portion of the oviduct throughout the winter. A possible explanation for the presence and absence of spermatozoa in these two physiologically distinct types has been advanced (Rahn, 1942); yet it remained to be determined exactly where the spermatozoa are confined during the long hibernation period, and what rôle the enlarged vaginal pouches play in this whole process.

The following observations are based upon mature "ripe" and "post-partum" female prairie rattlers collected during September from hibernating dens near Cheyenne, Wyoming. These snakes were kept at room temperature, and were dissected and fixed during December and January.

1 The authors extend their appreciation to Mr. Ray Maas for the photographic work in the accompanying illustrations.

A histological survey of the "ripe" female oviduct shows four distinct divisions: the infundibulum, the tuba, the uterus, and the coiled tube opening into an extremely large vaginal pouch. The approximate extent of each division is indicated in Figure 1. The uterus is one of the largest parts of the oviduct, and is characterized by tubular glands. Posteriorly, it merges into an extremely narrow, tightly coiled portion of the oviduct which is histologically similar to the vaginal pouch. Therefore, we may regard this entire region as part of the vagina. The vaginal pouch is lined with ciliated columnar epithelium, interspersed with numerous mucous cells. The vaginal epithelium is folded longitudinally; the folds are broad and flat in the pouch, but attenuated and sharp in the coiled portion. Between the epithelium and the outer musculature of the pouch there is much connective and muscle tissue, but this is less developed in the coiled portion. It is of much interest to compare histologically the "ripe" with the "post-partum" vagina, which does not contain seminal fluid. This pouch has a similar epithelium; yet it differs strikingly in that it is not folded and exhibits a much reduced connective and muscle tissue layer (Figs. 2, 3). This condition may be associated with the activity of the ovary and its secretions which are at a minimum in a "post-partum" animal.

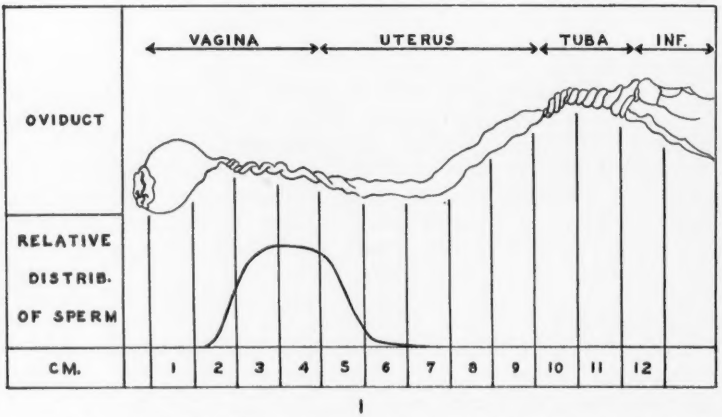
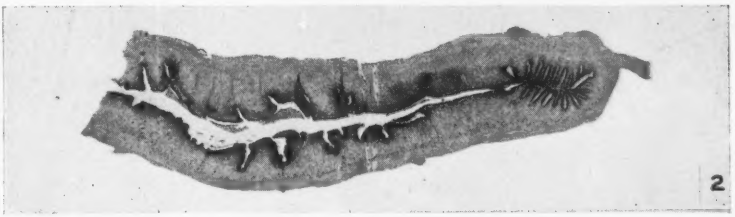
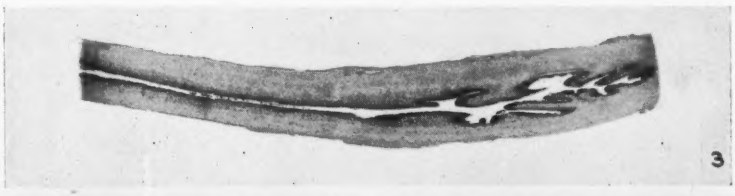


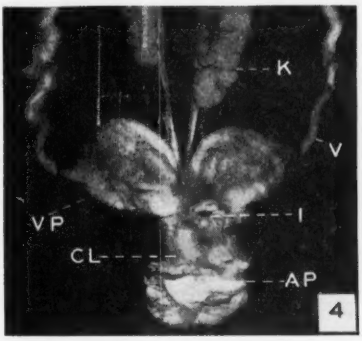
Fig. 1. A diagram to illustrate the relative concentration of sperm in the various regions of the "ripe" female oviduct.

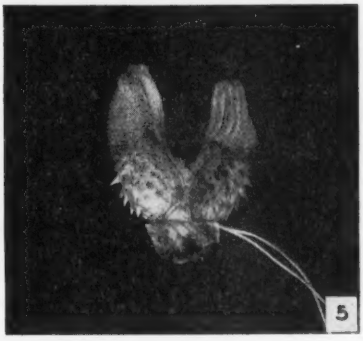
The distribution of the spermatozoa in the "ripe" females was studied histologically as well as by the smear technique of the living tissue. Both the smears and the paraffin sections were made at one centimeter intervals in order to determine the relative concentration of spermatozoa in various regions. The curve in Figure 1 indicates clearly that the majority of the spermatozoa are concentrated within a 4 centimeter length beginning at the most anterior portion of the vaginal pouch. This area includes the second to the fifth centimeters of the oviduct. Strangely enough the posterior end of the pouch contained no living spermatozoa.

Both the anterior and posterior limits of the distribution of spermatozoa were quite consistent in the various oviducts examined. There appeared to have been no physical obstruction or any coagulated seminal plug to account for this distribution. However, it is possible to assume that some physiological factor might operate to confine the spermatozoa to this limited area.









Figs. 2 and 3. Longitudinal sections of the vaginal pouches with the opening of the cloaca to the left and a portion of the coiled region of the vagina to the right. x 6. 2—"Ripe" female with sperm. 3—"Post-partum" female with no sperm.

Fig. 4. Ventral view of the posterior region of "ripe" female reproductive tract, arranged to show the size of the vaginal pouches, v.p.; vagina, v.; kidney, k.; intestine (cut end), i.; cloaca, cl.; and anal plate, a.p.

Fig. 5. Hemipenis (distended) of prairie rattlesnake.

As indicated above, the spermatozoa do not penetrate beyond the region of the compound glands that mark the beginning of the uterus proper. Secretions from these glands may inhibit the passage of the spermatozoa until a time just prior to ovulation when the final migration into the anterior oviduct must occur in order that the eggs may be fertilized.

The limited distribution of the spermatozoa raises the question of how the seminal fluid is conveyed to this area during copulation. The only description of copulatory adjustment in snakes is that of Pope (1941) for the colubrid *Liophis*. If copulation in the prairie rattler were similar, one would expect to find spermatozoa throughout the entire vaginal pouch. Thus the enormous muscular enlargement of this structure would seem of little importance. In *Liophis* the hemipenis is not bifurcated and lodges entirely within the large cloacal chamber. The spermatozoa presumably are conveyed by cup-like devices from the sulcus directly to the orifices of the vaginae.

In the prairie rattler, on the other hand, it would seem that the presence of a deeply bifurcated hemipenis and a comparatively short cloaca necessitate the simultaneous introduction of each ramus into the enlarged vaginal chambers. Each ramus of the distended hemipenis measures approximately 0.5-3 x 0.5-1 cms., and would presumably fit easily into a vaginal pouch of similar size (Figs. 4-5). The basal portion of the hemipenis has several rows of recurved spines which are graded in size, and undoubtedly secure the organ in the cloacal chamber during copulation. Calyces regularly arranged in 36-45 rows cover the distal two thirds of the hemipenis.

If each ramus is inserted and extended within the respective vaginal pouches, it would form an effective block to prevent the deposition of spermatozoa throughout the posterior extent of the vaginae. This block would be further strengthened by the calyces, which are arranged like suction cups at the most distal end of each ramus. Thus the seminal fluid would be conveyed in the sulcus spermaticus, and could be emitted only into the anterior part of the vaginal pouch or the coiled tube portion of the vagina. This evidence, of course, is circumstantial, and is in definite contrast to that recently presented by Pope.

SUMMARY: Histological examination of the vagina shows that it consists of a large muscular pouch, and a narrow coiled tubular portion. The vaginae of the "ripe" female, which posess spermatozoa, and of the "postpartum" female, which do not, have distinct histological differences. In the "ripe" females the spermatozoa are stored in the anterior portion of the vaginal pouch and in the remainder of the vagina throughout the hibernation period. The limited distribution of the spermatozoa and the anatomical features of the hemipenis, the vaginae and the cloaca in the prairie rattler seem to suggest that during copulation the rami of the hemipenis are inserted into the respective vaginal pouches. The hemipenis becomes distended, and completely blocks the vaginal pouches and cloaca so that the sperm can be deposited only at the most anterior termination of the sulcus spermaticus.

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An Anomaly in the Aortic Arches of a Bullfrog

By J. P. Linduska[1]

ABNORMALITIES in the circulatory system have frequently been recorded in the Salientia. O'Donoghue (1931) lists forty-eight accounts of such anomalies, all in *Rana temporaria*. Of these records, nine concern a transverse anastomosis joining the two external jugular veins; six were of abnormal abdominal veins; and seventeen others described anomalies in the posterior caval and renal portal veins. Only five of the forty-eight concern the arterial system, and of these, four are of abnormal pulmonary arteries. The fifth records the absence of the right systemic aorta posterior to the origin of the subclavian artery. The presence of a fifth aortic arch in *Rana temporaria* and the absence of a right anterior vena cava in *Rana esculenta* are described by O'Donoghue (1933). A subsequent paper by the same author (1935) gives twenty-two additional instances of variations in the vascular system of *Rana temporaria*. Only two of these records, an abnormal occipital and an abnormal subclavian, concern arteries.

Venous abnormalities in the Indian frog (*Rana tigrina*) have been observed by Khatib (1938), and an abnormal renal-portal in the American bullfrog (*Rana catesbeiana*) is described by Jnanendra (1938).

Many of the reported cases of abnormal vascular systems in frogs represent the retention of certain palingenetic vessels. The anomaly here described, in an adult male specimen of *Rana catesbeiana* Shaw, is an extremely radical one, not readily explainable. It appears to be the only record of an arterial anomaly in the American bullfrog.

The specimen here described is apparently normal in all respects except for the absence of one of the aortic arches and certain compensatory alterations in a second arch. The principal arteries showing the modifications are illustrated in Figure 1.

The conus arteriosus branches normally and the right truncus arteriosus divides to form the carotid, systemic and pulmo-cutaneous arches, all of which proceed normally. The left truncus arteriosus, however, gives rise to only a carotid and a pulmo-cutaneous arch, the systemic arch being entirely lacking on this side. The dorsal aorta is consequently formed by the posterior extension of the right systemic arch only, and is in this way suggestive of the condition seen in birds. The vessels of the left side then arise as follows: The enlarged carotid arch bifurcates to form the external and internal carotid arteries. The external carotid branch, which is of smaller diameter but longer than normal, comes off just beyond the division of the truncus arteriosus and runs forward to serve the thyroid, tongue, and muscles of the hyoid apparatus. The internal carotid runs forward and lateral to the point where it would correctly enter the roof of the mouth. Instead of entering at this point it continues laterally, finally giving rise to an enlarged occipito-vertebral branch. The remainder of this internal carotid then continues posteriorly as the subclavian. The palatine, cerebral carotid, and ophthalmic arteries which normally result from the breaking up of the internal carotid are lacking. The absence of these vessels seems to be compensated for in part by similarly

1 The author is indebted to Mr. Oscar Warbach for making the accompanying drawing.

placed branches from the enlarged occipito-vertebral artery. These branches terminate in the roof of the mouth, eye, and brain, the regions ordinarily served by the three missing branches of the internal carotid. The occipito-vertebral, after giving off the above branches, divides dorsally into the occipital branch running anteriorly into the head, and a posteriorly directed artery, the vertebral, extending along the spinal column.

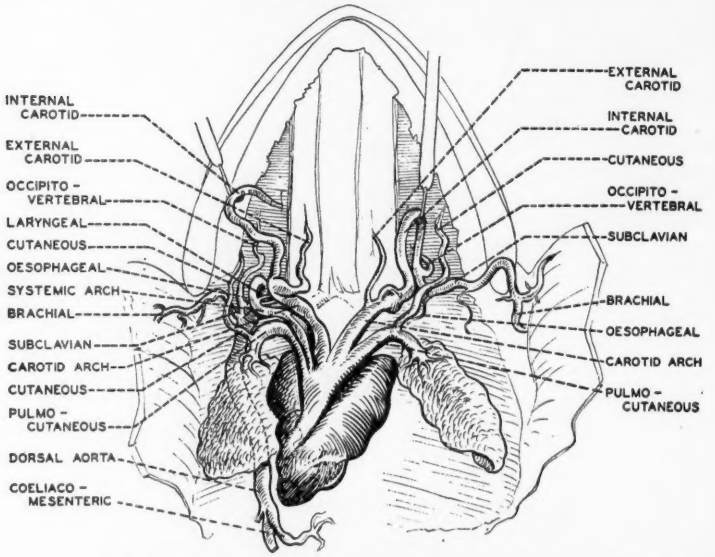

Fig. 1. Showing the larger arteries of both the right (normal) side and the left side, which lacks the systemic arch.

The laryngeal artery, ordinarily one of the first branches of the systemic arch, is lacking, and no similarly located artery is present on the left side. The esophageal branch of the systemic arch is present in this specimen as a branch from the subclavian. It arises just behind the point of division of the internal carotid into occipito-vertebral and subclavian arteries.

The pulmo-cutaneous artery, the only entirely normal arch in the left side, divides correctly into the pulmonary artery and the cutaneous with its ultimate ramifications.

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Methods of Collecting Freshwater Turtles[1]

By KARL F. LAGLER

NO comprehensive accounts of methods of collecting turtles for study, of limiting their numbers, or collecting them for the market are available in the literature. Turtle populations at some fish hatcheries and waterfowl sanctuaries require control (Lagler, 1940 b); turtles offer an important source of meat for human consumption (Clark and Southall, 1920; Lagler, 1942); and much remains to be learned about the biology of these animals. While collecting an extensive series of turtles for a food habits investigation in 1937 and 1938, I tested several different means of obtaining specimens of the aquatic species, namely, shooting, scapping, gaffing, spearing, "noodling," set-lining, and trapping.

Although some turtles may be shot while they are in the water, individuals that are sunning themselves on logs, muskrat houses, or other elevations offer better targets. Certain species are easily shot, but shooting is not effective if one wishes to recover specimens. Even if instantly killed, they are sometimes lost, and wounded specimens quickly hide themselves in soft bottom material or dense vegetation. For example, I once recovered only five map turtles (*Graptemys geographica*) of twelve shot while sunning on logs. The snapping turtle *(Chelydra serpentina)* and the soft-shelled turtle *(Amyda s. spinifera)* may be shot while they float with their heads out of water, usually at some distance from shore, but recovery is difficult. Shooting over water is hazardous and requires great caution and observance of existing laws.

Scapping with a long-handled dipnet, from a rowboat or while wading, yields some specimens. Smaller turtles are most readily caught with a dipnet. Snapping turtles are often too large and soft-shelled turtles too agile for this method of capture. Musk turtles (*Sternotherus odoratus*) especially have been easily obtained by using a dipnet at night from a boat with illumination from a jack light.

Opportunities for gaffing are likely to be fortuitous, but a gaff taken along in a boat during other operations will yield an occasional large specimen. A suitable gaff consists of a sharp-pointed, two-inch hook made on the end of a two-foot piece of three-eighths inch steel rod. This is fastened to a pole about six feet long. Turtles are most easily gaffed beneath the edge of the

1 Contribution from the Department of Zoology of the University of Michigan and from the Institute for Fisheries Research of the Michigan Department of Conservation. Substantial financial aid was given to the investigations on which this report is based by the American Wildlife Institute and by the Associated Fishing Tackle Manufacturers.

carapace. Of more than five hundred snapping turtles handled, only five were captured in this fashion. Gaffing is unsuitable for taking small turtles.

Opportunities for spearing, as for gaffing, do not present themselves frequently, and spearing requires considerable skill. Only a direct blow from a stout spear will penetrate the hard shell of most turtles, and the softer neck is difficult to hit. The carapace is an especially effective armor in larger snapping turtles, which afford the only suitable targets; other species, with the exception of the soft-shell, are too small, and the soft-shell is too swift and wary.

"Noodling" is a term used by professional turtle hunters for locating turtles in their places of hibernation. Some hunters "noodle" with their bare hands or feet, groping about under the banks of rivers or in the soft muddy bottoms of creeks or springs, especially where they discharge into lakes or ponds; others use a blunt steel rod to probe in such places. "Noodling" is particularly effective for collecting larger turtles, such as snappers; it is less effective for the smaller forms.

Set-lines may be used to catch turtles. An effective arrangement is to affix a fish hook by about twelve inches of steel wire (No. 16) to four feet of linen seine twine (No. 24 or equivalent) and to tie the line to the end of a stout but flexible pole six to eight feet long. In a general way it may be said that the larger the hook used, the larger the turtle that will be captured. A stout hook measuring about one inch from barb across to shaft is suitable for snappers of a medium size and larger. The hook is baited with fresh fish, fowl entrails, or other meat, and the pole is pushed far enough into the bottom so that the bait is a few inches above it. Set near a bed of aquatic vegetation, such as pond lilies, this device has provided me with many turtles.

Mr. Louis Marchand, of the University of Florida, has found that a skillful swimmer, provided with water goggles, can pursue turtles under water and catch them very efficiently by hand. He has applied this method in marking experiments.

Trapping is the most efficient means of taking turtles in most habitats. The conventional hoop-net type of turtle trap was employed extensively and effectively and is superior to the fyke net suggested by Ruthven (1912) and to other nets I have tried. Additional types of traps for turtles have been suggested by Pirnie (1935) and Surface (1908). The conventional hoop-net type of trap can be conveniently moved from one body of water to another, which is not true for other types. One type of trap consists of a four-foot square of two-by-fours, on the inner faces of which, and near the upper edge, forty-penny spikes are driven at a slight angle, and their heads clipped off. A bag three feet deep, made of three-quarter-inch poultry netting, is suspended from the lower edge of the timbers, and securely nailed all around. Placed in the water, this trap floats with the bag submerged and the spikes just above the water. Turtles clamber up onto the frame to bask in the sun and many, on retiring to the water, drop into the enclosure, from which they cannot escape. Turtles taken with this trap in my experiments were exclusively the basking species, the map turtle, painted turtle and Blanding's turtle. The snapping turtle, soft-shelled turtle and musk turtle, which were also present, were not taken.

Modifying the type of trap just described so that it would also take the non-basking species, another was constructed with a funnel-like entrance leading into each of two sides of the underwater bag. Poultry netting replaced the spikes above the water, rising upwards from the frame on all sides and curving inwards (Fig. 1, A). For bait, a punctured tin can of freshly killed

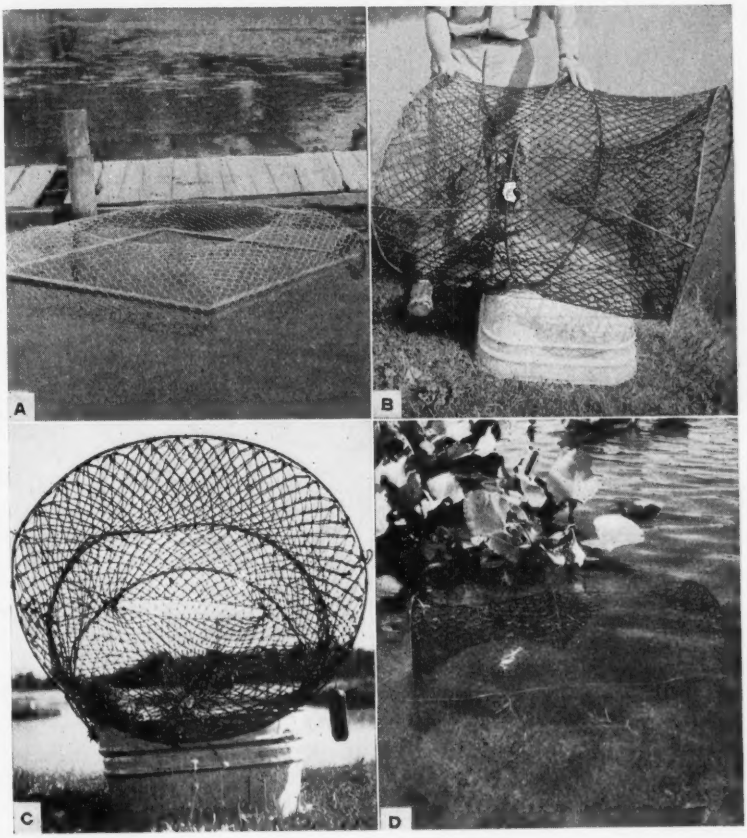

Fig. 1. Some types of turtle traps.
A. Floating trap. B. Conventional hoop-net trap; side view, note stretchers in place. C. Front view, looking into throat. D. Side view, trap properly set in water.

fish was kept suspended in the center of the bag. In one lake this trap caught musk turtles, snapping turtles, and soft-shelled turtles, as well as the basking species.

The most practical and efficient kind of trap for turtles is that commonly used by professional turtle hunters which has been briefly described by Pirnie

(1935). The traps (Fig. 1, B-D) used most and found satisfactory for scientific collecting were modified from this general type and were constructed to the following specifications:

Net: One-inch square mesh of No. 24 linen seine twine (three-inch square mesh is suitable for capturing larger turtles and is recommended for commercial trapping).
Length: Four feet.
Hoops: Three per trap, each thirty inches in diameter; made either of six-gauge steel wire with welded joints, or of wood.
Throat: Funnel shaped, eighteen inches deep from front hoop to aperture; aperture one inch high by twenty inches wide; corners tied to middle hoop.
Rear end: Closed by pursing string.
Preservative: Asphalt, applied hot to hoops and twine alike.
Stretchers: Nine-gauge steel wire, or wood; two for each trap.

Before setting a trap, such as just described, a container filled with bait is suspended in the middle just inside the mouth. Effective containers are discarded tin cans, about three and one-half inches in diameter and five to six inches tall, with covers attached at one edge. These cans when perforated with numerous small slits permit exudation of the juices from the bait. Whether or not the tin of the containers is shiny does not seem to make any difference in their attractiveness to turtles; the nature of the bait which they hold appears to be of greater importance. Whether shiny, rusty, or discolored, empty tin cans suspended in traps on test sets did not induce turtles to enter. Containers lengthen the usefulness of the bait since it cannot be eaten by the organisms attracted to it.

Several kinds of bait may be used; those effective for snapping turtles are apparently equally attractive for other species. Unspoiled watermelon rind seems particularly attractive to soft-shells. Map turtles are rather unresponsive toward all baits. Baits of greatest value are fresh fish or fresh entrails of fowl. Canned "Balto" (a prepared animal food with a fish base) and canned mackerel or salmon constitute moderately successful lures. Fresh beef, pork, and lamb seem to be relatively poor baits. The freshness of the material used as bait appears to be an important determinative factor in its value as a lure.

Best results are obtained when the traps are set so that the tops of the hoops are just out of water. If turtles can obtain air easily when they are trapped they are less active in their struggles to escape. As a result, other turtles seeking to enter the trap are not frightened away and larger specimens are not stimulated to tear the twine. When traps are set in water so deep that the turtles can not [illegible] in air, even individuals of the more aquatic species drown.

In some waters such as bog lakes or large rivers, it is often impossible to set traps on the bottom since the drop-off is so near the margins and the slope so steep. To trap these waters, four-inch logs, about as long as the trap, should be tied, two per trap, along the sides of the hoops. A trap so equipped will float with the tops of the hoops just breaking the water's surface. I have made good catches of turtles by this method. To prevent loss by drifting, traps set in this manner should be anchored to the bottom or shore. In rivers, traps set with the entrance downstream apparently give best results, doubtless because turtles move upstream into the scent of the bait. A long

stick driven into the bottom through the rear end of a river-set trap keeps it from being carried away by the current.

The length of the intervals between visits to the traps to tend them and remove the catch should be determined by the nature of the information desired. For my investigation a twelve-hour interval proved most effective. Frequent visits disturb turtles seeking to enter and thus reduce the catch.

It is necessary to practice some care in selecting the waters to be trapped. For the most part, water areas which have been recently used by commercial trappers are to be avoided if one is seeking study specimens, since most of the snapping turtles and also many of the other turtles may have been removed. "For the benefit of the sportsmen," it is the practice of some turtle trappers to destroy all turtles they may catch, other than the marketable ones.

Another reason for selection of the lakes, ponds, or streams or parts thereof to be trapped is that turtles are not equally abundant per unit area in all waters. There appears to be a positive correlation between bottom types and numbers as well as kinds of turtles present. Lakes or parts of lakes with predominately hard bottoms, for example, yield fewer turtles than those with extensive areas of soft bottom. Beds of white water lily (*Nymphaea odorata*) and yellow pond lily (*Nuphar advena*) are profitable trapping grounds for some species.

Indiscriminate destruction of turtles is to be discouraged. It has been shown (Lagler, 1940a) that turtles may be beneficial as well as detrimental, in aquatic communities, to man's best interests. Extermination of turtles should never be undertaken until scientific investigation has shown them to be unquestionably undesirable in a local situation. It is apparent that conservation laws need to be enacted to preserve some turtle species, especially those of commercial significance. Limitation of the mesh in commercial turtle traps to three inches is especially recommended. Before any of the means here described are employed for collecting turtles, conservation authorities in the area in which they are to be used should be consulted as to the acceptability of the method.

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Apparent Changes in Phenotypic Ratios of the Characins at the Type Locality of *Anoptichthys jordani* Hubbs and Innes

By C. M. Breder, Jr.

THE type locality of *Anoptichthys jordani* Hubbs and Innes has now been visited by four separate parties over a period of six years. This spot, marked "Pool II" on the map of Bridges (1940) and Breder (1942) which is "Station 1" in the text of the latter paper, has had specimens taken from it by each of these four parties, making the series so collected strictly comparable as to locality. The first two parties, Señor Salvador Coronado in 1936 and Dr. Myron Gordon in 1939, took only the typical white blind fish such as described by Hubbs and Innes (1936). The third party, the Aquarium expedition of 1940, took a few fishes showing various degrees of eye development in this pool and found a gradient to a greater quantity of eyed forms as the cave was further penetrated and closer approach was made to the Rio Tampaon in which live the eyed deriving stock, *Astyanax mexicanus* (Filippi). Various features of these fishes are discussed by Breder and Gresser (1941a, b and c) and Breder (1942). This third party was the first scientific group to penetrate further than Pool II.

A party of Cornell students, Mr. Ben Dontzin, Mr. Seymour Parker, and Mr. Edwin Ruda, while visiting Mexico in 1942 were kind enough, among other things, to revisit La Cueva Chica, where this locality is situated. This visit was made during the rainy season and collecting was reported to be very difficult. However in their collection there is still a greater percentage of eyed fishes and some showing further development of pigment than found on diligent search by the party of the third trip.

These data are given in Table I in which they are compared with those of the earlier visits. Although the numbers on which the percentages are based are small there are several reasons incident to the collecting that lead us to believe that the difference cannot be merely accidental but does actually reflect a real condition. The 1936 and 1939 collections were made by scooping up the specimens at the margin of Pool II and number something less than 100 each. The third party preserved 36 fish and the fourth 28. When other than blind and white types were taken in 1940 it was thought that such had merely been missed by the earlier parties. In this connection it should be borne in mind that the eyed forms with a sensitive retina, even if not forming a proper retinal image, are badly frightened by the lights necessary to collecting and are for that reason harder to find or catch. In fact they were not caught by the third party until after such types had been discovered in Pool III where they were relatively abundant. Subsequent collecting in Pool II discovered their presence there in the small quantities noted in Table I for that year. These figures may indeed be somewhat weighted and show a larger percentage than may have been actually present. In other words, the third party sought out such fishes in 1940 after their presence had been

detected. In 1942 the rainy season was on and the water was higher and roiled, not clear and limpid as in the dry season. This led to great difficulty because of the excessive slipperiness of the floor. Only dip nets were used and to this extent the fourth trip resembled the first two. Consequently these later figures would be expected to be low in eyed fishes. As they are higher for the 1942 party, it can only mean that these were much more abundant, very likely considerably more so than the figures indicate.

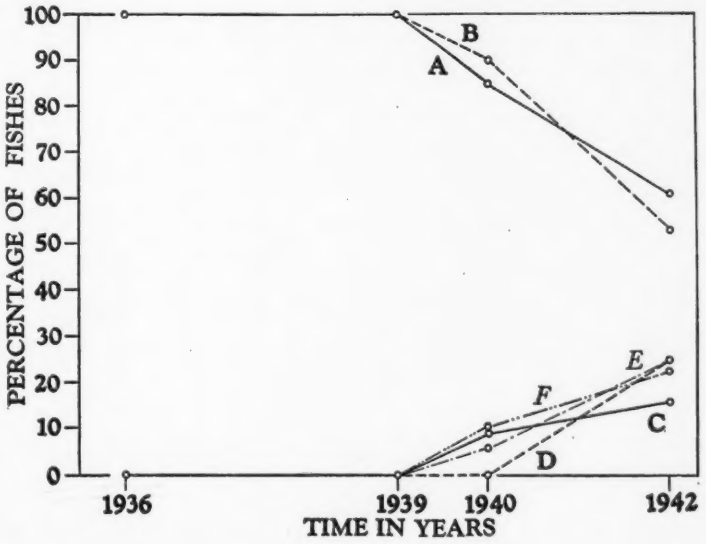

Fig. 1. Graph of apparent changes in phenotypic ratios in the population of Pool II of La Cueva Chica, the type locality of *Anoptichthys jordani* Hubbs and Innes.

A. (Solid line) Percentage of fully blind fish. B. (Dashed line) Percentage of fully pigmentless fish. C (Solid line) Percentage of 'normal' eyed fish. D. (Dashed line) Percentage of fully pigmented fish. *E* (Dot and dashed line) Percentage of fish with both types of sunken eyes. *F* (Double dot and dashed line) Percentage of fish with neither fully developed pigment nor with it completely absent; the types marked 'little,' 'moderate' and 'considerable' in Table I.

The only explanation for this condition would seem to be that in some way a contaminant of eyed fish was introduced into Pool II subquent to the first visit or at least not much prior to it. This opinion is based on the apparent speed in the change of population constitution in that place. There are evidently only two possibilities; natural causes or human agency. Since the author is personally acquainted with all persons involved with these collections and has discussed their activities with them there is absolutely no reason to suppose that the latter may have been the case. That some local people undertook such a fish planting operation is even more unlikely. As the ground water drains from seepage springs from higher ground down to the level of the Rio Tampaon, except that in the rainy season water washes

in the mouth of the cave by way of an otherwise perfectly dry gully, the natural entry of fishes from that end of the cave is out of the question. All of the *Astyanax* and other river fishes live at a level much below that of the cave, for miles around. Entry would appear to be from the subterranean river connection, the progress of which doubtless accounts for the gradient of eyed forms which was found by the third party in a marked form in the pools below that of the one under discussion. The most reasonable explanation would thus seem to be that some subterranean passage opened very recently which permitted the river fish to gain an easy access to the cave. When the first two parties had visited the cave it had either not yet occurred or the fishes had insufficient time to work back to this pool and were just getting a foot-hold when the third party visited, but by which time they were well established in the lower parts of the cave. By the time the fourth visit occurred nearly half the population of Pool II were other than fully blind and white. It is a pleasure to point out in this connection that in early conversation on the faunal situation in this cave Dr. C. L. Hubbs suggested an hypothesis to the effect that such a condition might account for the findings of the third party. The present data could be used to support such a view.

Apparently further penetration into the cave by the river fish to positions above the lowest pool, which is at river level, can only be made successfully at the time of high water in the rainy season or at some intermediate water stage not present in the dry season. Possibly the actual penetration to Pool II is slight and most of the increase in eyed forms is due to interbreeding. The fully eyed forms of the fourth collection are all of a small size, probably not more than six months old. Genetic studies,[1] as far as they have gone, indicate that the mating of eyed and pigmented fish with blind ones results in all eyed and pigmented offspring, at least in ordinary lighted aquaria, while the blind white fish breed true. Although much must yet be done in order to understand the genetic situation in these fishes, which presents some puzzling features, the above could well be expected and should make for a rapid spread of eyed and pigmented phenotypes in an initially pure culture of blind and white fish.

If this evidence can be taken at face value it would seem to indicate that the blind fish which have been called *Anoptichthys jordani* by Hubbs and Innes were once separated genetically from the river population of *Astyanax mexicanus* from which they certainly have been originally derived. Since they have evidently been rejoined by the river population at a time when they were still able to interbreed freely the question of whether the intermediates should be looked upon as hybrids or merely genetic variations of the same stock would seem to be largely academic until more facts are available.

There is, however, another possible interpretation that could be placed on this situation. If it is assumed that on each rainy season, fish of the eyed sort work into the cave, sometimes as far as Pool II and sometimes not so far, dependent on the particular possibilities of an individual season, and that

1 This work is being carried out in the laboratories of the Department of Animal Behavior of the American Museum of Natural History.

then these eyed forms do not thrive very well in the dark environment and gradually disappear, the present condition could be obtained, with sometimes few and sometimes many eyed forms present. It is yet to be shown whether the eyed or eyeless have any advantage, environmental or psychic, under such conditions, although the initial establishment of the blind population would seem to require some sort of selective process. The first trip and the fourth were made in the rainy season while the other two were in the dry season. The fourth collection, made in September, contained the most eyed forms and it could be assumed that they were destined to disappear slowly during the dry season while there were no further entries being made, were it not for the fact that the first trip was also made during the wet season, in November. The third trip when some eyed fish were found, was made in March and the second trip in April, both earlier than the others. To clarify this, it would be necessary to make periodic collections during a full year, in order to determine if there is an annual cycle in the phenotypic ratios in the population of this cave.

TABLE I

PHENOTYPIC CONDITIONS IN THE FISHES OF LA CUEVA CHICA[1]

	EYE CONDITION			
	SUNKEN EYE			
	Blind	Covered	Uncovered	'Normal' Eye
1936	100	0	0	0
1939	100	0	0	0
1940	85	6	0	9
1942	61	4	21	14
	PIGMENTATION			
	None	Little	Moderate	Considerable	Full
1936	100	0	0	0	0
1939	100	0	0	0	0
1940	90	2	6	2	0
1942	53	11	11	0	25

[1] Figures are given as percentage of the total collection from Pool II for each year.

Table I gives the basic data which are shown graphically in Figure 1. From this it is clearly evident that the blind and white fish have fallen from 100% to a little over half of the population. Since there is not complete correlation between eye condition and pigmentation these lines do not follow an identical descent. Likewise the presence of 'normal' eyed forms has risen to 14%. Following the usage of Breder and Gresser (1941a) and Breder (1942) the word "normal" is used to include any fully formed eye in normal position regardless of its diameter. These eyes range from 5.26 to 7.76 in diameter in percent of standard length and show a mean of 6.79%, which is very close to the figure given by Breder (1942) for fish in the same size group for the 1940 visit, which was 7 for the entire cave. Full pigmentation, equivalent to that of the river fish, has risen to 25%, being entirely absent in the earlier visits. The intermediate conditions of eyed status and pigmen-

tation have likewise each shown an upward trend. The term "sunken eye" following the usage of the same authors indicates an eye below the surface level and more or less obviously defective, while "covered" and "uncovered" indicates the presence or absence of tissue over the remnant eye. In brief, both eyeless and pigmentless forms have decreased in relative numbers and all forms of pigmentation and eyes have increased without exception from 100% and 0% respectively, the presence of fully pigmented individuals appearing only in the 1942 collection. These figures are all quasi-independent and not merely various mathematical ways of saying the same thing, as there exists considerable independence of the pigmented and eyed condition, as already indicated by Breder (1942). Thus, despite the small numbers of fishes collected, each item points consistently in the same direction, and as already pointed out, the data of the third and fourth trip, if anything, underestimate the extent of the changes in phenotypic proportions.

Since the months in which collections were made do not follow any orderly sequence in regard to number it would not seem likely that such a supposed annual cycle has any real basis. If one assumes that the situation as found may be accounted for by a relatively rare flooding, permitting river fishes to work up as far as Pool II, it would also have to be assumed that these would disappear in time by some selective process or by some swamping-out process by the presumably more numerous blind fish, rather than a general spread of the genes for an eyed condition, although the latter may proceed for some time after the introduction of river fish. Field and theoretical genetic data on these fishes are as yet too scant to make any postulates on such a concept. Even if it could be shown to be true, it would mean that the cave stock in Pool II at least was frequently separated from the river population and whatever process that led to blindness in the first place once again took hold to eliminate the eyed forms. This is as much as to say that the progress of differentiation, presumably tending to separate the river fish from the cave fish, is irregularly interrupted and set back by periodic intermingling. In fact it is conceivable that this item alone has prevented the La Cueva Chica stock from evolving into a form that could no longer interbreed with the river fish.

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Studies of Cyprinodont Fishes.[1] XIX. *Xiphophorus pygmaeus*, New Species from Mexico

By Carl L. Hubbs and Myron Gordon

In order to make a name available for use in papers by the junior author and others, we anticipate the appearance of our long unfinished revision of the xiphophorin fishes by herein naming and diagnosing the pigmy swordtail:

Xiphophorus ***pygmaeus,*** new species

Types.—The holotype is an adult male 25 mm. in standard length (Pl. 1, fig. 1), collected by Myron Gordon and Salvador Coronado in Río Axtla of the Río Panuco system, at Axtla, San Luis Potosí, México, on April 14, 1939; University of Michigan Museum of Zoology, Cat. No. 124365. With the holotype there were seined 173 paratypes, 14 to 32 mm. long, including 16 completely transformed males (UMMZ, 124366). A transforming male (UMMZ, 108601), 16 mm. long, was collected by Gordon, Whetzel and Ross at the same locality, on April 20, 1932. Others were collected by an expedition of the New York Zoological Society in Río Axtla at Axtla and in an "arroyo between Río Axtla and Río Moctezuma," both on March 25, 1940. The largest specimen (UMMZ, 124340), a somewhat aberrant adult female 40 mm. long, the only one not designated as a paratype, was taken by Gordon and party in Río Matalpa, at Matalpa, San Luis Potosí, 13 miles north of Tamazunchale, on April 14, 1939. Live stock from Axtla, therefore closely related to the type series, has been maintained by the junior author for use in genetic research. The habitat of the species is described by Gordon (1940:173).

Diagnosis and Relationships.—On the basis of gonopodial and other characters this species clearly enters the tribe Xiphophorini Hubbs (1924: 10, Pl. 3, fig. 4). This group, comprising the genera *Platypoecilus* Günther and *Xiphophorus* Heckel, had already been recognized, though not named, by Regan (1913: 980, 1004–1005, figs. 172 D–E). The gonopodium of *X. pygmaeus,* unlike that of *X. montezumae* Jordan and Snyder, does not approach that of *Platypoecilus:* the recurved terminal segment of ray 5a is fully developed and the distal serrae on ray 4p are short. However, the sword-like prolongation of the lower caudal rays of the adult males, heretofore thought to be diagnostic of *Xiphophorus,* is but weakly developed (Pl. 1, fig. 1), or rudimentary—often less produced than in *Platypoecilus xiphidium* Hubbs and Gordon. The number of dorsal rays (Table 1) averages even lower than in *Platypoecilus variatus,* but the distinction from other species of *Xiphophorus,* especially from *X. montezumae,* is also only an average one. Therefore the number of dorsal rays can no longer be used as a generic feature.

Because the other distinctions between *Platypoecilus* and *Xiphophorus* tend to break down (the gonopodial characters in *X. montezumae* and the caudal sword character in *P. xiphidium* and *X. pygmaeus*), and since the

[1] Henceforth the senior author's series of "Studies of the Fishes of the Order Cyprinodontes" will appear under the abbreviated title here adopted—partly for brevity and partly in consistency with his idea that the ranking of higher groups had better be avoided.

two genera are notoriously interfertile in aquaria, the separation of the genera rests on an uncertain basis. But since the name *Xiphophorus* would take precedence should the genera be united, the reference of *pygmaeus* to *Xiphophorus* will probably not become a problem.

TABLE I

NUMBER OF DORSAL RAYS IN *Xiphophorus*

	Number of dorsal rays									
	9	10	11	12	13	14	15	16	No.	Av.
X. montezumae	..	3	175	264	25	1	..	..	468	11.67
X. pygmaeus	1	72	155	5	..	..	..	..	233	10.70
X. hellerii hellerii	..	..	51	429	66	1	..	..	547	12.03
X. hellerii strigatus	..	..	30	198	145	8	..	..	381	12.34
X. hellerii brevis	..	..	1	29	237	250	32	1	550	13.52

Another striking feature of the pigmy swordtail is its tiny size—less than 2 inches, usually less than 1.5 inches. The coloration is also distinctive: the black lateral band along the middle of the side, from chin to caudal, is extremely bold, and is usually set off in an area more or less clear of pigment; the broad and black band along the lower edge of the caudal peduncle, in some specimens continued forward on the side of the trunk, is also striking, as is the dark blotching of the upper sides (a variable feature, however). In one color phase the males lose the striped appearance. The typical striped phase is of two types, one plainly colored and the other golden. Typically the dorsal fin of the adult male bears a subbasal row of black spots and the fin is margined with blackish. In a few males the caudal is edged with dusky. On the top of the snout there is a pair of blackish blotches, one about each nostril. The males are usually more deeply pigmented than the females.

The scales are relatively large (in the holotype numbering 26 from head to end of hypural and 7 from front of dorsal downward and backward to the anal fin, not counting minute scales on the base of the gonopodium). The outer pelvic ray is short, flanked by a membranous expansion and separated by a notch from the elongated second ray. Measurements in holotype, stepped as usual into the body or head: body depth, 3.7; caudal peduncle depth, 5.6; head, 3.5; head width, 1.8; snout, 3.3; bony interorbital, 2.6; eye (very large), 2.7.

This species has been mentioned (but not given a scientific name) by the junior author in three abstracts and one paper (Gordon, 1939–1943).

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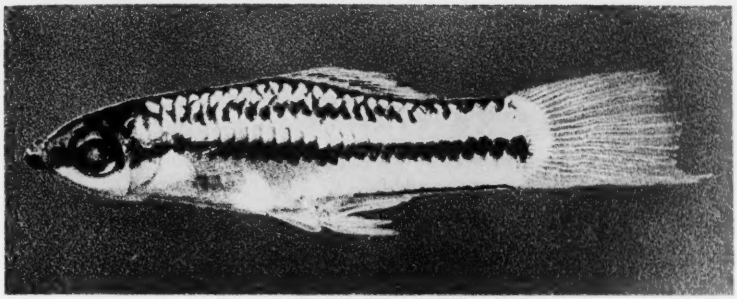

Fig. 1. *Xiphophorus pygmaeus*, holotype.

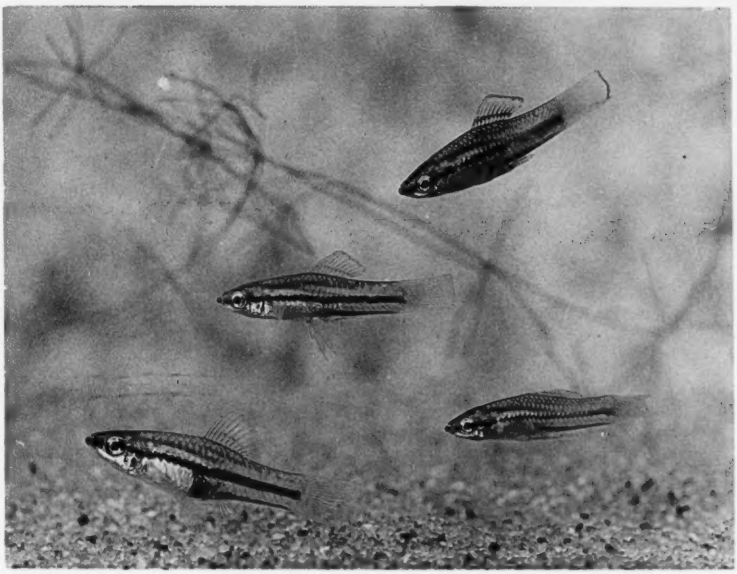

Fig. 2. Four adults of *Xiphophorus pygmaeus* in aquarium: 3 males and (lower left) one female.

Photographs by Myron Gordon

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A Comparative Study of the Weberian Ossicles in North American Ostariophysine Fishes[1]

By LOUIS A. KRUMHOLZ

SINCE no work was done on the function of the Weberian ossicles, the purpose of this investigation was morphological and systematic. The comparative morphology of the bones which make up this apparatus has been studied in 16 species of the Eventognathi and Nematognathi.[2]

The Weberian apparatus occurs in certain fishes, which, by reason of this structure, are grouped as the Ostariophysi. The apparatus consists of a series of four bones, situated on each side of and derived from the first four vertebrae. These ossicles, in anteroposterior sequence, are the claustrum, scaphium, intercalarium and tripus. They form a chain connecting the spinal medulla and the air-bladder. Weber (1820) believed that their function was auditory. Hasse (1873) and Wright (1884) adopted the view that they were hydrostatic in function. Sagemehl (1891) accepted the theory of Hasse but uncritically looked upon the ossicles as registering changes in atmospheric pressure.

The group of fishes possessing Weberian ossicles was originally named Ostariophysaea by Sagemehl (1891). Jordan (1929) defined the series Ostariophysi (Plectospondyli) as "fishes with the anterior vertebrae modified to connect with the air-bladder and inclosing an organ of hearing." According to Jordan, this series embraces the orders Eventognathi, Nematognathi,

[1] Contribution from the Zoological Laboratory of the University of Illinois and the Institute for Fisheries Research, Michigan Department of Conservation.

[2] My gratitude should be expressed to Prof. L. A. Adams, under whose direction the investigation was carried on, for his helpful guidance and encouragement; to Dr. David H. Thompson and the Illinois Natural History Survey for furnishing equipment and assistance in the collection of specimens; and to Dr. Carl L. Hubbs for critical advice on the manuscript.

Heterognathi and Gymnonoti. The first two of these orders are widespread throughout the north and south temperate zones and furnish the material for this investigation. The other two occur only in the tropical regions and are not included. The Eventognathi include the carp, dace and minnows (Cyprinidae), the suckers (Catostomidae), and the loaches (Cobitidae). The Nematognathi or catfishes are represented in this study by the North American catfishes (Ameiuridae).

In his original paper, "De aure et auditu hominis et animalum," E. H. Weber (1820) gave a description of the anatomy of the Weberian ossicles in *Silurus glanis*. Since then various papers have appeared describing these bones in additional species. An anonymous paper on the anatomy of the Weberian apparatus in *Cyprinus brama* appeared in the Isis von Oken in 1821. Reissner (1859) treated the ossicles in a group of siluroid fishes. Nusbaum (1881) described the anatomy of the Weberian apparatus in some Cyprinidae. In one of the first North American investigations of the Weberian ossicles, R. R. Wright (1884) presented a thorough description of these bones in *Amiurus catus* (*Ameiurus nebulosus*). He first described the fusion of the second, third and fourth vertebrae. Bridge and Haddon (1889, 1892) gave the initial account of the anatomy of the Weberian ossicles of the Nematognathi as a group. Their investigations included 92 species referable to about 50 genera. They suggested the name "Weberian ossicles" rather than auditory ossicles. They described the "elastic spring apparatus" ("Springfederapparat," Johannes Müller, 1842), an outgrowth of the transverse process of the fourth vertebra in some catfishes. In 1899, Nusbaum and Sidoriak described the Weberian apparatus in *Cobitis* [*Misgurnus*] *fossilis*. Bloch (1900) compiled the work previously done on the anatomy, function and nomenclature of the Weberian apparatus. Nusbaum (1908) gave a detailed description of the development and morphology of the Weberian ossicles in *Cyprinus carpio*. Evans (1924, 1925) worked on the anatomy of the air-bladder and Weberian apparatus in *Rutilus rutilus* and about 12 other species of Cyprinidae. Chranilov (1926, 1927, 1929, 1930), Adams (1928), Wunder (1936) and von Frisch (1938) are the most recent investigators of note who have described Weberian ossicles.

Weber, in 1820, first described this chain of bones which have subsequently become known as the Weberian ossicles (Bridge and Haddon, 1889). He named them the claustrum, stapes, incus and malleus. Subsequent authors proposed the nomenclature as follows:

Author and Date	Name of Bones in Anteroposterior Sequence			
	1	2	3	4
Weber (1820)	claustrum	stapes	incus	malleus
Mueller (1853)	Claustrum	Steigbügel	Ambos	Hammer
Bridge and Haddon (1889)	claustrum	scaphium	intercalarium	tripus
Thilo (1908)	Hinlage	Deckel	Lenker	Hebel

Recently, in Europe, there has been a reversion to the original nomenclature, for instance by Nusbaum (1908). In supporting Weber's names, Chranilov (1930) stated: (1) there can be no confusion of the Weberian ossicles with the auditory ossicles; (2) the substitutions for Weber's nomen-

clature cannot be successful for several reasons; (3) the nomenclature of Weber (1820) is widespread in the literature. In this country, the names introduced by Bridge and Haddon (1889) seem to be held in preference. The advantage of this nomenclature is that it avoids any possible confusion with that of the non-homologous auditory ossicles in the Mammalia.

Material and Methods

The fishes investigated are of three families: the Catostomidae (suckers), the Cyprinidae (carp, dace and minnows) and the Ameiuridae (North American catfishes). Representative species of these groups were taken in Illinois, from the Rock and Illinois rivers, and in Lake Decatur (Macon County) and Horseshoe Lake (Alexander County). The taxonomy of Hubbs and Lagler (1941) has been used. The Weberian apparatus was studied in the following species:

Catostomidae: *Megastomatobus cyprinella* (Valenciennes), bigmouth buffalo (7 specimens); *Ictiobus niger* (Rafinesque), black buffalo (9); *Ictiobus bubalus* (Rafinesque), smallmouth buffalo (11); *Carpiodes cyprinus* (LeSueur), quillback (7); *Carpiodes carpio carpio* (Rafinesque), northern carpsucker (5); *Carpiodes velifer* (Rafinesque), highfin sucker (6); *Catostomus commersonnii commersonnii* (Lacépède), common white sucker (12); *Minytrema melanops* (Rafinesque), spotted sucker (6); *Moxostoma erythrurum* (Rafinesque), golden redhorse (6); *Moxostoma anisurum* (Rafinesque), silver redhorse (5); *Moxostoma aureolum* (LeSueur), northern redhorse (8).

Cyprinidae: *Cyprinus carpio* Linnaeus, carp (15); *Notemigonus crysoleucas auratus* (Rafinesque), western golden shiner (5).

Ameiuridae: *Ictalurus lacustris punctatus* (Rafinesque), southern channel catfish (8); *Ameiurus melas melas* (Rafinesque), northern black bullhead (5); *Ameiurus natalis natalis* (LeSueur), northern yellow bullhead (7).

All fishes used were fresh. The Weberian ossicles were removed by one of three methods:

1. Some fish were heated in water for 30 minutes at 50° to 60° C., to facilitate the removal of the flesh from the skeleton. These cooked fish were useless for a detailed study of the muscle and ligament attachments, but upon cleaning and drying, the bones were in excellent condition for studying the contour, fine fenestrations and near-microscopic markings. If fish bones are cooked at high temperatures for prolonged periods of time, they deteriorate and become chalky and are unfit for morphological studies.

2. Dissections were made on some frozen specimens. The myomeres were stripped away from the fatty tissue in which the ossicles were embedded. As the frozen fatty tissue melted, it was easily removed and the ossicles remained in their natural positions.

3. Dissections were also made on untreated fish. This method proved the least satisfactory, because it tended to obscure the details of the structure. The ligaments are so strong that pieces of the bone are often chipped off.

After complete cleaning, the bones were placed in xylol to dissolve the fat. Alcohol was used to remove the xylol. Some of the bones were bleached with hydrogen peroxide, but the cooking process alone generally leaves the bones sufficiently clean for morphological study.

Dissections of the entire apparatus *in situ* were made on *Moxostoma erythrurum, M. aureolum, Notemigonus crysoleucas auratus* and *Ictalurus lacustris punctatus*. The air-bladder and ossicles were left intact. The viscera were removed without deflating the air-bladder. The Weberian apparatus was exposed by carefully removing all muscular, connective and fatty tissue, and those bones which obscured the examination of the ossicles. The ventral processes of the second and third vertebrae, which enclose the tripus in the Eventognathi, were not removed.

With the aid of a binocular microscope, drawings (Pls. I–III) were made of the ossicles on the right side of each of the species listed. The tripus is shown in dorsal aspect in all Eventognathi and in lateral aspect in all Nematognathi. In all drawings the intercalarium is figured in lateral aspect and the scaphium in medial aspect. The claustrum is shown in lateral aspect in all fishes excepting *Catostomus c. commersonnii, Cyprinus carpio* and *Notemigonus c. auratus*, in which the dorsal aspect was figured in order to show the longitudinal contour of the bone.

Eventognathi

In the Eventognathi the ventral processes of the second and third vertebrae are fused together (Pl. I, Fig. 2).

The claustrum, a small saucer-shaped bone set in the fibrous tissue of the wall of the neural canal, forms the medial surface of the *"atrium sinus impar"* (Weber, 1820). It is an integral part of the apparatus and its lateral edges are contiguous with those of the scaphium (Pls. I–III).

The scaphium (Pls. I–III), which acts as a lid over the claustrum, consists of three parts: (1) the cup-shaped lid which forms the lateral surface of the *atrium sinus impar;* (2) the sharp articular process for articulation with the body of the second vertebra; and (3) the rounded process for the attachment of the ligament from the intercalarium.

The intercalarium (Pls. I–III) varies in shape in the different species. It is connected by ligaments to the ventrolateral border of the scaphium and the anterior end of the tripus. The size and shape of the intercalarium seem to depend, to a greater or lesser degree, on the structure of the anterior ramus of the tripus. If that ramus is long and curved, as in *Moxostoma* and *Minytrema* (Pl. II), the intercalarium is usually small and does not articulate with the second vertebra, but if the anterior ramus of the tripus is short, as in the buffalofishes (Pl. I, Figs. 4–6) and the carp (Pl. III, Fig. 1), the intercalarium is larger and articulates directly with the body of the second vertebra.

The tripus (Pl. I, Fig. 1) is the largest bone in the series and consists of five parts: (1) the body or central part of the bone, which is more or less fenestrated; (2) the anterior ramus, connected by a ligament to the intercalarium; (3) the articular process, which is located on the medial side of the body of the bone and articulates with the second vertebra; (4) the posterior ramus, longer and thinner than the anterior ramus, extends posteriorly toward the air-bladder and supports (5) the transformator process, a long, delicate strip of bone which is embedded in the tunica externa of the air-bladder.

Nematognathi

In all the Ameiuridae investigated, the centrum of the second vertebra and the centra, neural arches and spinous processes of the third and fourth vertebrae are fused into what appears to be a single bone (Pl. III, Fig. 4). In some species of nematognathous fishes there is a modification of the transverse process of the fourth vertebra to form the "elastic spring apparatus" (Bridge and Haddon, 1889), as shown in the same figure. The first vertebra is rudimentary.

In the Weberian apparatus of the Ameiuridae (Pl. III, Figs. 3–7) there are but three functional ossicles. The most anterior bone, the claustrum, does not form an integral part of the series. When present it serves only to strengthen the wall of the neural canal, and is embedded in fibrous connective tissue immediately posterior to the occipital bone and dorsal to the scaphium (Pl. III, Fig. 3), but is not in direct articulation with the scaphium.

The scaphium (Pl. III, Figs. 5–7) has two processes extending out from the point of insertion of the interosseous ligament: (1) the spoon-shaped process which covers the opening in the bony wall of the neural tube where the claustrum, if present, is embedded in fibrous tissue, and (2) the articular condyle, which articulates with the body of the second vertebra.

The intercalarium in the Ameiuridae (Pl. III, Figs. 3–7) is a small piece of bone embedded in the ligament between the scaphium and the tripus.

The tripus (Pl. III, Figs. 3–7), as in the Eventognathi, is the largest of the ossicles, but in the Nematognathi it has only three distinct parts: (1) the anterior ramus, a long, smooth, rounded process which extends forward and is connected, by a ligament, with the scaphium; (2) the articular process which is on the medial side of the bone near its middle, and which articulates with the body of the third vertebra; and (3) the posterior ramus, a flat, flexible process, which extends posteriorly and then ventrally past the "elastic spring apparatus" and is intimately connected with the tunica externa of the air-bladder.

In the Weberian apparatus of the Eventognathi there are three ligaments (Pl. I, Fig. 1): (1) a small band between the scaphium and the intercalarium, (2) a similar band connecting the intercalarium with the anterior ramus of the tripus, and (3) a fibrous band between the posterior ramus of the tripus and the body of the fourth vertebra. In the Nematognathi (Pl. III, Fig. 3) only the first two ligaments described for the Eventognathi are present, unless the elastic spring apparatus represents the ligament between the posterior ramus of the tripus and the fourth vertebra.

Differences in the Weberian Ossicles

In all the eventognathous fishes studied in this investigation, the structure of the Weberian apparatus follows a single pattern. There are, however, differences between genera and species which appear to be of taxonomic value.

Thus differences appear when one compares the ossicles in the several buffalofishes (*Megastomatobus* and *Ictiobus*). In *M. cyprinella* (Pl. I, Fig. 4) almost the entire anterior ramus of the tripus is fenestrated, whereas in *I. niger* (Pl. I, Fig. 5) and *I. bubalus* (Pl. I, Fig. 6) only the body is

fenestrated. The intercalaria of *M. cyprinella* do not have the alar condyle which is developed in *I. niger* and *I. bubalus*. The scaphia of these three fishes are more or less similar, but the saucer-shaped claustra of *M. cyprinella* closely resemble those of *I. bubalus*, whereas the claustra of *I. niger* are nearly pyramidal.

In the genus *Carpiodes* the distinctions lie mainly in the tripodes of the three species examined. In *C. cyprinus* (Pl. II, Fig. 1) there is little fenestration, and the body is sculptured with longitudinal grooves. In *C. carpio carpio* (Pl. II, Fig. 2) there is practically no fenestration and there is a Y-shaped brace which supports the anterior and the posterior rami and the articular condyle. In *C. velifer* (Pl. II, Fig. 3) the body is rather highly fenestrated.

Only one species of *Catostomus* (*C. c. commersonnii*) was studied (Pl. II, Fig. 4). One of the more outstanding features is the posterior curvature of the transformator process. The posterior ramus is much thinner than in the other suckers. The intercalarium is a long spicule of bone and the claustrum is a thin plate convex on both sides. The scaphium is similar to that of the other suckers.

In *Minytrema melanops* (Pl. II, Fig. 5) the tripus is finely sculptured and there is a supporting arm from the articular condyle to the anterior ramus. The intercalarium seems rudimentary in that it does not articulate with the second vertebra. The articular condyle of the scaphium is highly sculptured. The claustrum differs slightly from that of the other suckers, for the "saucer" is set on a bar of bone which fits into the wall of the neural canal.

Some differences in the apparatus were disclosed in the genus *Moxostoma*, of which three species were studied. The general contours of the tripodes of *M. erythrurum* (Pl. II, Fig. 6) and *M. aureolum* (Pl. II, Fig. 8) are similar but are considerably different from that of *M. anisurum* (Pl. II, Fig. 7). The body of the tripus is highly fenestrated in *M. anisurum*, less so in *M. erythrurum*, and least in *M. aureolum*. Perhaps as a compensation for the rudimentary condition of the intercalaria, the anterior rami of the tripodes of the three species of *Moxostoma* are relatively longer than in the other suckers. The scaphium in *M. erythrurum* is rather square and has a long process for the insertion of the interossicular ligament. The claustrum in *M. erythrurum* is shaped somewhat like a mushroom and is tightly fitted into the wall of the neural canal. The scaphia and claustra in *M. anisurum* and *M. aureolum* do not differ greatly from those of the other Eventognathi.

The Weberian ossicles are quite different in the two cyprinid fishes that were studied. In *Cyprinus carpio* (Pl. III, Fig. 1) the tripus is large and sturdily built, with only a small amount of fenestration in the body, whereas in *Notemigonus c. auratus* (Pl. III, Fig. 2) the tripus is rather light and its body is finely fenestrated. The anterior ramus is short in *C. carpio* and long in *N. c. auratus*. The intercalarium of *C. carpio* is forked and in *N. c. auratus* it is rudimentary. The scaphium in *C. carpio* has a rather long process for the connection of the interossicular ligament, whereas in *N. c. auratus* it is similar to that of the suckers. The claustrum in the carp has a shape of two cones placed apex to apex with the bases hollowed out, and in the golden shiner the shape is that of two saucers placed base to base.

All of the Weberian ossicles are comparable in the three species of Ameiuridae studied, but there are some small differences between the genera. In the tripus of *Ictalurus l. punctatus* (Pl. III, Fig. 5) there is no supporting arm from the body to the posterior ramus as in the two species of *Ameiurus*. No specific differences between *Ameiurus m. melas* (Pl. III, Fig 6) and *Ameiurus n. natalis* (Pl. III, Fig. 7) were observed.

Conclusions and Summary

The Weberian apparatus of 13 species of eventognathous fishes, referable to eight genera, and of three species of nematognathous fishes, classed in two genera, were studied.

Drawings of each of the Weberian ossicles from each species were made with the aid of a binocular microscope. Each drawing is based on an examination of several individual bones, and is thought to be representative of the structure of the bone for the species considered.

The Weberian ossicles of the Eventognathi are strikingly different from those of the Nematognathi. The general shape of the tripus provides a new distinction between these orders. The transformator process at the posterior end of the tripus in the Eventognathi makes up nearly the entire posterior ramus of the tripus in the Nematognathi. The intercalarium is a rudimentary pea-shaped bone in the Nematognathi, whereas in the Eventognathi this bone typically articulates with the second vertebra. In the Eventognathi there are four functional ossicles, and in the Nematognathi there are only three. In the latter group the claustrum merely serves to strengthen the wall of the neural canal, and has no physiological significance.

The morphology of the Weberian ossicles is stable within each species studied, and the comparative studies have shown that there are distinctive differences between genera and even between the species referred to the same genus. The generic and specific distinctions are particularly pronounced in the Eventognathi.

Differences in the morphology of the Weberian ossicles provide characters which should prove valuable in the systematics of recent and perhaps also of fossil ostariophysine fishes.

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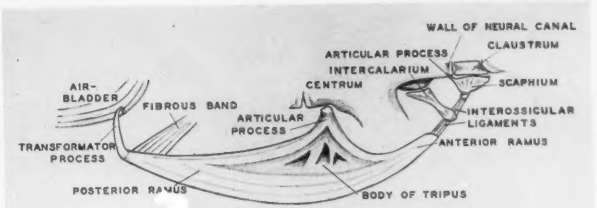
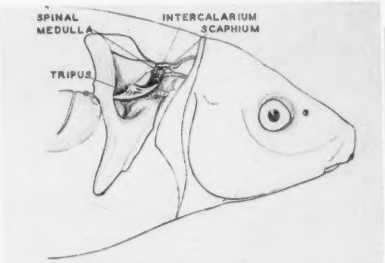


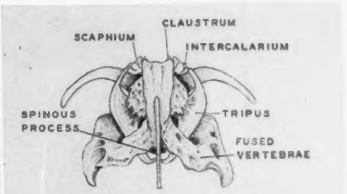
DIAGRAM FOR EVENTOGNATHI

FIG. 1



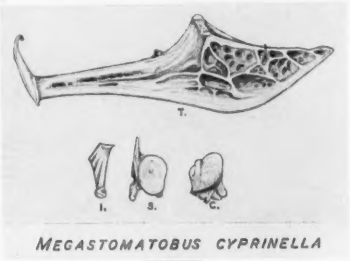
MOXOSTOMA ERYTHRURUM

FIG. 2



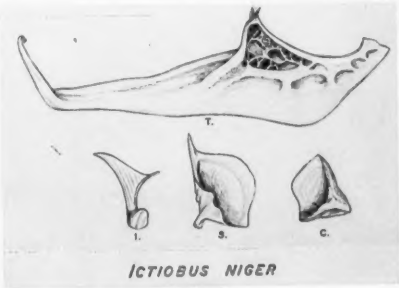
MOXOSTOMA ERYTHRURUM

FIG. 3



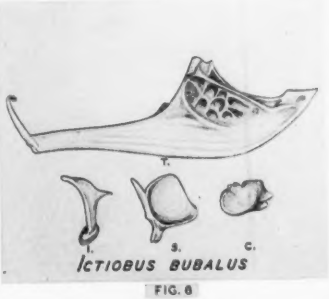
MEGASTOMATOBUS CYPRINELLA

FIG. 4



ICTIOBUS NIGER

FIG. 5

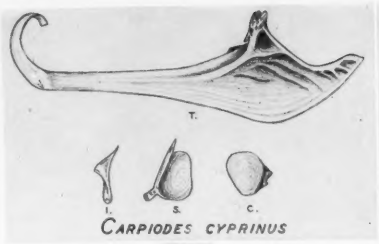


ICTIOBUS BUBALUS

FIG. 6

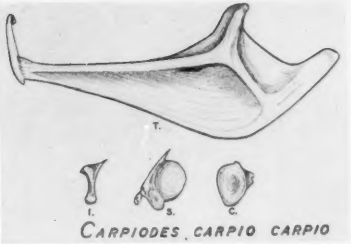
T = tripus
I = intercalarium

S = scaphium
C = claustrum



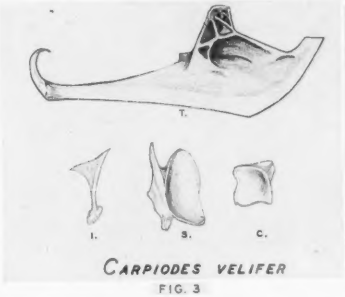
CARPIODES CYPRINUS

FIG. 1



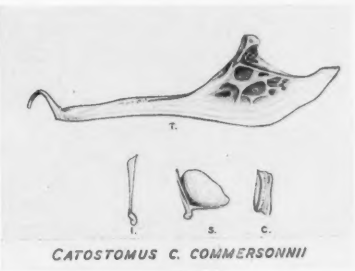
CARPIODES CARPIO CARPIO

FIG. 2



CARPIODES VELIFER

FIG. 3



CATOSTOMUS C. COMMERSONNII

FIG. 4

MINTREMA MELANOPS

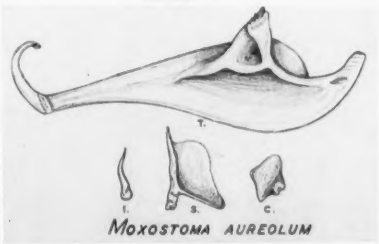
FIG. 5

MOXOSTOMA ERYTHRURUM

FIG. 6

MOXOSTOMA ANISURUM

FIG. 7

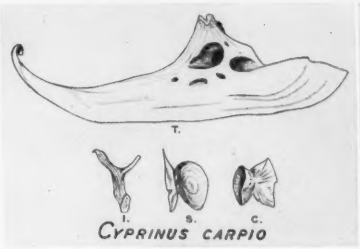


MOXOSTOMA AUREOLUM

FIG. 8

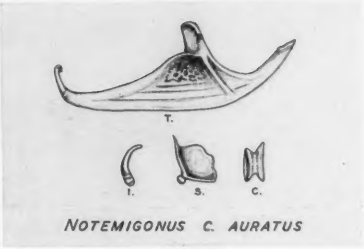
T = tripus
I = intercalarium

S = scaphium
C = claustrum



CYPRINUS CARPIO

FIG. 1



NOTEMIGONUS C. AURATUS

FIG. 2

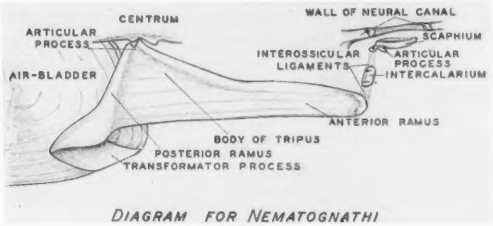
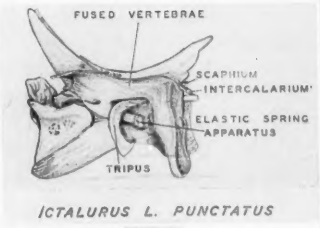


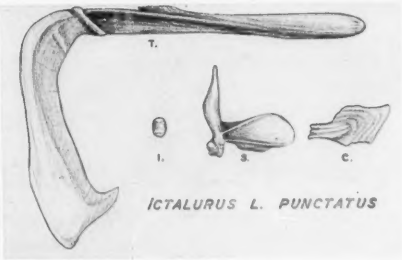
DIAGRAM FOR NEMATOGNATHI

FIG. 3



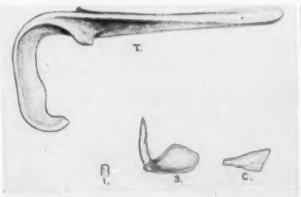
ICTALURUS L. PUNCTATUS

FIG. 4



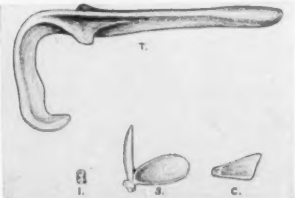
ICTALURUS L. PUNCTATUS

FIG. 5



AMEIURUS M. MELAS

FIG. 6



AMEIURUS N. NATALIS

FIG. 7

T = tripus
I = intercalarium

S = scaphium
C = claustrum

Observations on the Spawning of the Sculpin, *Cottus semiscaber*

By James R. Simon and Robert C. Brown

While collecting fish from spring creeks near Jackson, Wyoming, on February 20, 1940, our attention was drawn to egg clusters of the sculpin, *Cottus semiscaber* (Cope). Again the following year, on March 2, numerous egg masses were seen on the under-surface of rocks in the springs where sculpin were collected.

Beginning February 15, 1942, the springs were visited numerous times for the purpose of establishing more exactly the time and extent of the spawning season, and for gathering other pertinent data.

Two springs were visited regularly: Tanner Spring, with a temperature of 48° F., and the Government Ranch Spring, with temperatures of 45° to 48°. Both springs are tributary to Flat Creek, Teton County. In the headwaters of both, where the sculpin spawn, the bottom is composed of coarse gravel, interspersed with large irregularly shaped rocks. Tanner Spring contains an abundance of water cress. At lower levels of both creeks the bottoms are excessively muddy. Sculpin do not spawn in the muddy areas. The velocity of the water seemed to make no difference in the choice of a "nest rock." Egg clusters were found where the current was rapid and also where it was almost non-existent.

During the 1942 season, egg clusters were first seen on March 6 at Tanner Spring. Some had reached the eye spot stage on this date; others were newly laid. Eggs collected then hatched within five days in an aquarium. On March 20, March 25 and April 5, at the same spring, both eyed and uneyed eggs were located. No eggs could be found on the last visit to the spring on April 16.

At the Government Ranch Spring the first cluster of eggs (uneyed) was found March 25 (water temperature 45° F.). On April 16, April 28 and May 10, gravid females were located, as well as egg clusters (water temperature 48°). The last eggs, which were eyed, were found May 26.

This sculpin's eggs are usually salmon colored; occasionally a light yellow mass of them is seen. They are strongly adhesive and are laid in clusters on the under-surface of rocks (Plate I), rarely on vegetation or on the stream bottom if rocks are available. Shallow, scooped-out depressions or nests, usually occupied by the sculpin, were found under some rocks. Eggs may be removed easily from the rocks without separating from each other. The clusters average in size about 24 x 40 mm., and are usually about the depth of seven eggs. Although no compound clusters were found, occasional egg clusters of slightly different color and in different stages of development were observed close together on the same rock, possibly the product of different females. The individual eggs averaged 2.47 mm. in diameter; those from the ovaries of females ready to spawn measured 2.2 mm. There was an average of 354 eggs per cluster in those collected from rocks, and an average of 629 eggs in the ovaries of females nearly ready to spawn. Measurements and counts were made from six egg clusters.

When five days old, 30 sculpin fry that had been artificially hatched averaged 6.9 mm. in total length. At the time the yolk sac had not yet disappeared. Other artificially hatched fry were kept alive 22 days, 15 of these averaged 8.6 mm. in total length.

The average size of 12 spawning males (recognized readily by the bright orange or white edging of the first dorsal fin) was 85.3 mm. in standard length, considerably larger than that of 12 females, which was only 68.5 mm.

The actual spawning of the sculpin could not be observed because of their habit of laying eggs in a narrow space under the rocks. However, the male fish was close to the eggs on 27 occasions, in nine of which the eggs were eyed. Rarely were developing eggs found unaccompanied by the male fish. As pointed out by Smith (1922), in the spawning of *Cottus meridionalis* (=*bairdii*) in Michigan, there seems to be a paternal brooding habit. On 15 occasions both male and female were with the uneyed eggs; on 38, pairs of sculpin with no eggs were seen; of these the females were all gravid. A male or female fish alone, with no eggs, was seen frequently.

	Male and Female	Male Alone	Female Alone
No Eggs	38	21	13
Uneyed Eggs	15	18	10
Eyed Eggs	0	9	0

Only once were more than a single pair of fish observed together, when two males and two females were with one clump of eggs. One of these females was spent, the other had not spawned.

The stomachs of the spawning sculpin, of both sexes, were examined for food content. Small quantities of fresh water shrimp, snails and aquatic insects were present in most stomachs. The stomach of one small male was gorged with sculpin eggs and newly hatched fry. The cluster near which the male was found, when compared with eggs and fry in the stomach of the specimen, was found to contain eggs in the same state of development, that is, partially hatched.

In both springs discussed, over a period of three years, the sculpin spawned between February 20 and May 26, a season of approximately 96 days. Smith (1922) says of *C. meridionalis:* "During several successive years I have found eggs in various stages of development during April and May, which points to a rather extended breeding season, but my data do not determine its precise duration." Whether or not the extended season is due to the sculpin's tendency to use spring waters for spawning is not known. Other waters in the vicinity were ice-bound during most of the time observations were made. It is likely that altitude plays little part in determining the spawning time, since *C. semiscaber* seems to prefer spring waters. The altitude at Jackson, Wyoming, is approximately 6200 feet.

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Wyoming Game and Fish Department, Cheyenne, Wyoming.

Fig. 1. An upturned rock at Tanner Spring, showing the egg cluster of a sculpin.

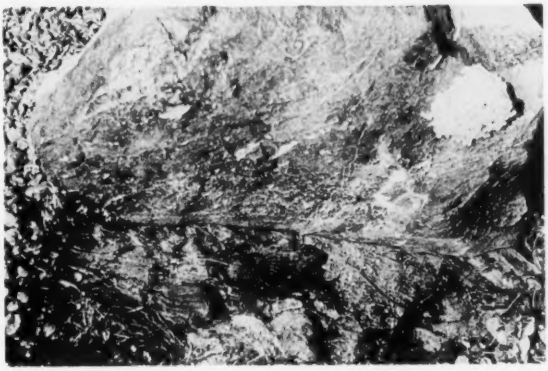

Fig. 2. Male and female sculpin in position under rock. Newly laid eggs are adhering to rocks.

Notes on Sawfish, *Pristis perotteti* Müller and Henle, not Previously Reported from the Waters of the United States

By J. L. Baughman

FEW data are available on American sawfishes, especially in the semi-tropical waters of the Gulf of Mexico, which border Texas, Mexico, and the Central American countries. Meek and Hildebrand (1923) report no sawfishes from the Atlantic coast of Panama, and Dr. Hildebrand tells me that he saw none from that side of the isthmus on trips in 1935 and 1937, "which does not mean that the species is not there or is scarce, for I did very little work on the Atlantic side."

Günther (1868) records *Pristis antiquorum* Latham from the "Atlantic and Pacific oceans (Chiapam)." This fish was also reported by Meek (1907), and by Regan (1908) who, under the heading of *Pristis perotteti*, says that this was "probably the sawfish that has been recorded from Lake Nicaragua by Gill and Bransford (1877)."

Of the coast between Nicaragua and Texas little is known, only four or five papers having been published on that section. Bean (1890) makes no mention of any species of *Pristis* at Cozumel Island. Jordan and Dickerson (1908) collected none at Vera Cruz or Tampico. Breder's (1927) paper has not been examined, but neither Barbour and Cole (1906) nor Hubbs (1936) list any species of sawfish.

In Texas waters Jordan and Gilbert (1882) record a specimen of *P. pectinatus* Latham from Galveston, reference to which is also made by Evermann and Kendall (1892). Reed (1941) includes it in a list of the elasmobranchs of the Texas coast.

This form, according to Jordan and Everman (1896) and Breder (1929), is the only member of the genus actually recorded from the coasts of the United States. It may be easily identified by the tooth count of the rostrum, which ranges from 24 to 32 per side (Jordan and Evermann, 1896), but which Mr. Stewart Springer, of Islamorada, Florida, tells me occasionally drops to as low as 20. He has never seen it below that figure.

It was with considerable interest, then, that I first examined a saw presented to the Rice Institute Collection of Fishes, in which the tooth count of the saw was only 18/18. This number lies well below the diagnostic count of *pectinatus*.

The fish from which it had been taken was caught in an otter trawl by a shrimp boat operating out of Freeport, Texas. An effort to acquire additional information having failed at Freeport, examination was made of a large number of dried saws at Galveston, Texas. Those with the low tooth count occurred in about a 1 to 3 ratio with saws of *pectinatus*. Fishermen with whom I talked were of the opinion that the two species were present in about equal numbers, and, curiously enough, considered the marked variation in saws as a sexual dimorphism, and were loathe to believe otherwise.

Proof that this belief was erroneous was given later in the summer when seven of these fish were caught at Galveston by E. F. Reid. These fish ranged

in weight from 500 to 1300 pounds, and in length from 14 feet to 17 feet 4½ inches. The largest was a female; several of the smaller ones were males.

The specimens belonged, as far as can be determined without extensive comparisons, to the species *Pristis perotteti* Müller and Henle, a form originally described from the West African coast.

Description

The saws of five specimens taken by Mr. Reid had the low tooth counts of 18/18, 18/18, 16/17, 19/19, 18/19, and, in addition, presented interesting differences from saws of *P. pectinatus* with which they were compared. The teeth were much heavier, averaging slightly over 11 mm. in width, as compared with slightly less than 9 mm. for a series from *P. pectinatus;* and their thickness averaged approximately twice that of the latter form. The average length of the teeth on a saw of *perotteti* 650 mm. in length, was 37 mm.; while on a saw of *pectinatus* 945 mm. long, the average length of the teeth was only 25 mm.

The general appearance of the saws differs considerably also. Those of *perotteti* taper evenly from base to tip, and the first eight or nine teeth on each side of the base have a distinct downward dip, their upper surface continuing in the same plane with the downward slanting dorsal surface of the rostrum. The remainder project horizontally, or almost so; and there is no notch or offset in the rostrum at the base of the teeth, as there is in those specimens of *P. pectinatus* that I have examined. Moreover, the teeth of *P. perotteti* have a tendency to be much more evenly spaced than are those of *P. pectinatus,* which may be widely spaced at the base, but set very closely together in the distal quarter of the rostrum. Width of the saw of *P. perotteti,* at the distal pair of teeth, is contained from 2 to 2½ times in the width at the basal set. Teeth of *P. perotteti* are trenchant and deeply grooved posteriorly.

Color of the saws in the two species is quite different, those of *P. pectinatus* being noticeably lighter gray on the dorsal surface than are those of *P. perotteti.* In fact, the latter are often golden brown on the posterior portion, which color is continued over the upper body of the fish. In this the description agrees with Day (1889), when he says "Color—reddish brown superiorly, becoming white along the abdominal surface."

In proportion to the length of the body, the saws of *P. perotteti* are shorter than are those of the other species. Evermann and Bean (1898) remark of *P. pectinatus* that a saw 6 feet long would indicate a fish of 12 to 15 feet. In the 17 feet 4½ inches specimen of *P. perotteti,* the saw was slightly over 40 inches. In a 600 (?) pound specimen of *P. pectinatus* from Galveston, the length of the body was approximately 3 times that of the saw, while in two of Mr. Reid's fish, the body length was 3½ times the length of the saw. Annandale (1909) does not believe that this is a constant characteristic, however. In two specimens examined by him, the first, 656 cm. in total length, had a saw 145 cm. long, while in the second, 561 cm. in total length, it was 130 cm. long.

P. perotteti probably attains considerably greater size than does *P. pectinatus.* Boatmen at Aransas Pass state that the most common sawfish there is one under 10 feet "with a longer saw." The big ones, those with the

heavy saws, reach lengths up to 20 feet. One measuring 18 feet 7 inches and weighing 1200 (?) pounds was caught there on June 16, 1940. It is clearly *P. perotteti,* as the photograph furnished me by Mrs. Lyle McCaleb, of Harbor Island Transportation Company, shows. Reid's fish of 17 feet 4½ inches weighing 1300 pounds has already been noted. Another from Aransas Pass measured 16 feet 4 inches, and three from Galveston measured 14 feet, 14 feet 7 inches, and 15 feet overall.

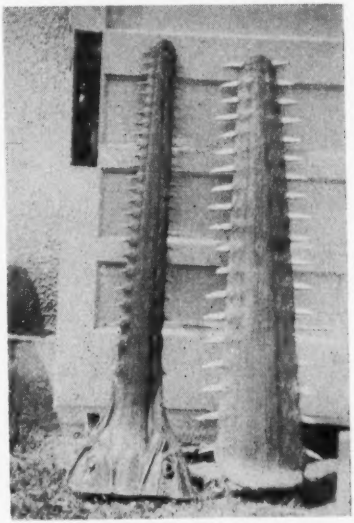

Fig. 1. Saw of *Pristis pectinatus* (left), and one of *P. perotteti* (right).

A photograph of one which would undoubtedly have been a giant of its kind, had it retained its saw, was also sent me by Mrs. McCaleb. This fish, which measured 15 feet, had lost this appendage at some earlier time in its life, and presented only a perfectly cicatrized wound as evidence of its ever having been present. Of this specimen, Mrs. McCaleb says: "He had at one time been harpooned and the place was healed, and small crabs [copepods?] were living in the healed wound. He had been shot, also, and in fact was a battle-scarred veteran."

The ability of this fish to survive such wounds gives abundant evidence of its vitality, but the absence of the saw cannot but bring on speculation as to whether this weapon is really necessary to the existence of the species.

Both species breed off the Texas coast, according to the shrimp fishermen at Galveston and Freeport. Gravid females are frequently taken in their trawl nets during the early months of the year. No certain instance of this is known to me for *P. perotteti,* but young of *P. pectinatus* are reported as plentiful in Brown Cedar Cut, off the Laguna Madre, in May and June. A saw from that locality, now in my possession, measures only 170 mm. from tip to basal teeth. This was taken May 5, 1942.

Range

This species is almost world-wide in its distribution. Fowler (1941), who synonymizes it with *P. microdon* Latham, gives an extended record of its occurrence in eastern seas, and, in his earlier publication (1936), gives an almost equally long list of occurrences in the tropical Atlantic. Günther (1870) records it from places as far apart as Bandjermassing, the West Indies, and the mouth of the Zambesi, in Africa. Evermann and Marsh (1900) report it from the West Indies. Metzelaar (1919) and Garman (1913) give "both sides of the Atlantic." Fowler (1919) reports it from Surinam. Nevertheless it has not hitherto been reported from the coasts of the United States, although Breder (1929) suggests that it may be found in the waters of our southern states. An obscure reference by Caton (1879) may refer to this species, as *P. antiquorum* does not occur in Texas; but this name has also been used as a synonym for *P. pectinatus* (Radcliffe, 1916) and may refer to that species. Caton gives no description, so the identity of his specimen cannot be determined.

Mr. Stewart Springer, during our correspondence in regard to these fish, wrote me as follows:

> I have seen one saw taken from a specimen at Key West with a 17-18 count. Chester Thompson, the man who collected the saw, says that it came from a shorter, heavier specimen than the typical Florida sawfish. On the saw . . . I have the following notes: "Largest tooth ⅝ x 2½ inches. Breadth of saw at tip 3¾ inches, at basal teeth 7¾ inches." Note that measurements of this saw closely parallel those given by Garman for an Amazon specimen of *P. microdon*.

If this fish was *P. perotteti*, this constitutes an isolated occurrence, as all other specimens mentioned in this paper were taken from Texas waters, where the range is from Port Arthur on the east to Brownsville on the south. I have an excellent photograph of a specimen furnished me by the Port Arthur Chamber of Commerce; at Galveston numerous saws were examined, in addition to the specimens taken by Mr. Reid, and those from Port Aransas. None have been reported from Louisiana, Gowanloch (1923) listing only *P. pectinatus*, and Martinez gives no record of either form from Tamaulipas, Tabasco, Vera Cruz, or the coasts of Quintana Roo.

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Ichthyological Notes

THE ARTIFICIAL PROPAGATION AND GROWTH OF THE COMMON WHITE SUCKER, *CATOSTOMUS C. COMMERSONNII*, AND ITS VALUE AS A BAIT AND FORAGE FISH.—In 1937 I started a series of experiments that were designed to determine which of the bait and forage fishes are best suited to pond culture. It was believed that the information obtained would be useful to bait dealers who raise their own minnows and to hatchery men who are engaged in rearing such game fish as northern pike, wall-eyes and the black basses.

The rearing of bait minnows is generally regarded as desirable, because the seining of the supply in natural waters seems to have led to local depletion. As a result it has often proved increasingly difficult and expensive to obtain adequate numbers for the bait trade and the reduction in the natural forage fish population may be deleterious. Restrictions on minnow seining have been invoked and more rigorous protective measures have been contemplated.

For similar reasons it has been found desirable to rear forage fish to serve as food for game fish being reared in hatcheries. Good growth often results from the feeding of live food, and other foods are becoming increasingly expensive and sometimes impossible to obtain, particularly under present war conditions. The current tendency to rear game fish to larger size before they are planted increases the need for an adequate supply of forage fish.

There may also be a need for culturing such coarse fishes as the suckers to increase the supply of fish for human consumption, and this need may become pressing during the war. The hatcheries may be called on to produce such fish, for establishment or increase in natural waters and in artificial ponds. Some hatchery ponds may even be used to rear fish for human food.

An experiment on the artificial propagation of the common white sucker was conducted at the Drayton Plains Fish Hatchery of the Michigan Department of Conservation. On May 2, 1937, 6 quarts of sucker eggs were obtained from White Lake in Oakland County, Michigan, by personnel of the Drayton Plains Hatchery, and the writer. Ordinary stripping technique was employed and Mr. A. T. Stewart, Superintendent of

the hatchery, used corn starch to prevent adhesion of the eggs. From observations that have been made since, this was a necessary precaution, because the eggs of the sucker are slightly adhesive. According to Mr. Stewart there were 1,000 eggs in a fluid ounce (32,000 per quart), as he determined by counting the eggs in two 1-ounce samples. The eggs hatched in regular hatchery jars in twelve days at an average water temperature of 53° F. Immediately after hatching the fry remained at the bottom and along the sides of the jars and were unable to rise and leave the jars as wall-eyed pike and whitefish do. The constant rolling probably caused the loss of a large percentage of the newly-hatched yolk-fry. A total of only 3 quarts of fry survived, although more than 90 per cent of the eggs had hatched. More of the fry could no doubt be saved by placing the eyed eggs, just before hatching, on cheesecloth trays in ponds.

On May 16, one quart of sucker fry (approximately 32,000 fish) was placed on a cheesecloth tray in a small experimental pond that had a surface area of about 0.1 acre and a maximum depth of 3 feet. It was not considered necessary to add fertilizer to the pond because this was the first season that the pond had been used. In order to determine whether the suckers would take artificial food, feeding was attempted over about a two-week period during August. Finely ground sheep liver, ground dog biscuit, or a mixture of these two were fed once daily during the two-week period. Observations disclosed that the suckers took artificial food off the bottom of the pond.

Observations during the latter part of June revealed that fishes other than the sucker were present in the pond. Seining yielded a number of wall-eyes, yellow perch and creek chubs. All of these predatory fish were removed from the pond, but they had undoubtedly consumed some of the small suckers. These fish had evidently been placed in the pond with the sucker fry. They must have entered the hatching jars containing the sucker eggs, from jars of the same battery that contained these other species. The wall-eyes averaged about 3 inches and the perch about 2 inches in total length.

The pond was drained on November 17, 1937, just 186 days after planting. There were removed at this time a total of 2,775 suckers, representing an 8.67 per cent survival, and weighing 28.75 pounds. This production was at the rate of 27,750 fish and 287.5 pounds per acre. The suckers averaged 86.5 mm. (3.4 inches) in total length, and ranged from 54 to 163 mm. (2.1 to 6.4 inches).

During the past several years, two Michigan minnow dealers have attempted to raise suckers for bait. One of these dealers has not reported yet whether he had any success or not. The other dealer collected and fertilized some sucker eggs and placed them on the sandy bottom of a small pond. Some of these eggs hatched and the fish made excellent growth during their first summer.

In the spring of 1942, 12 quarts of sucker eggs were collected and hatched in jars at the Lydell Hatchery. Eight quarts of sucker fry were placed in a small pond containing wall-eye fry on May 4. From this time until May 28, young suckers were in evidence about the pond. Stomach examinations that were made on several wall-eyes collected on May 28 revealed that some of the suckers had been eaten by the wall-eyes. On this date the wall-eyes had an average total length of 35 mm. and the suckers averaged 22 mm. Suckers were not observed about the pond after about the first of June, and none were collected after May 28. The wall-eyes increased very little in length after the supply of suckers was exhausted.

In 1941, Ray Huntington, a commercial minnow dealer in Minnesota, started to raise suckers for the bait market (Horton, The Conservation Volunteer, Minnesota Department of Conservation, 4 (24), 1942: 29-30). Huntington used the jar method of hatching suckers, and transferred the young to rearing ponds. He was able to hatch three different batches of eggs in 1942 by obtaining eggs from three different spawning runs of adult suckers in different streams. Many of the suckers were large enough to be seined and sold for bait during the month of July in 1942. That it is possible to incubate sucker eggs in jars has also been mentioned by Raney and Webster (1942, Copeia: 139-148).

The writer wishes to thank Messrs. A. T. Stewart and Claude Lydell for their cooperation during the course of these experiments. Thanks are also due Dr. Carl. L. Hubbs, who kindly read this manuscript and offered suggestions and criticisms.—W. F. Carbine, *Michigan Department of Conservation, Institute for Fisheries Research, Ann Arbor, Michigan.*

ON A LARGE *XENOGRAMMA* FROM PERU.—We refer a large, dark mackerel taken by Mr. Michael Lerner at night on rod and reel from over 100 fathoms depth, 25 miles straight off Cabo Blanco in northern Peru (30 miles up the coast from Talara), January 25, 1941, to *Nesogrammus thompsoni* Fowler (1923, Bishop Mus., Occ. Pap., 8 (7): 376), described from the Honolulu market, and to *Xenogramma carinatum* of Waite, as described and figured by Myers (1932, Trans. San Diego Soc. Nat. Hist., 7 (11): 114, Pl. 7) from California. It resembles these fish in dentition, proportions, in the peculiar squamation with numerous scattered pores over the body, and in color. The fish is familiar to the Peruvian fishermen, and its flesh is reputed to have the same purgative quality for which that of *Ruvettus* is well known.

Nesogrammus Evermann and Seale (1907) is a synonym of *Grammatorcynus* Gill (1862), considerably smaller fishes than any that are described referable to *Xenogramma*, and it is possible that these last are adults of *Grammatorcynus*, for the two genera seem to be close. However, they show remarkable differences in dentition, squamation, etc., and we follow Myers in recognizing *Xenogramma*, and in tentatively referring all Pacific records to *X. carinatum*.

The type of *thompsoni*, 965 mm. long, is the largest individual in this genus of which we have found a description, but our specimen, measuring 1045 mm. standard and 1220 mm. total length, is some 10 inches larger still. It is to this we attribute certain notable differences which it shows, particularly the absence of any lateral line. Its gill-rakers are obsolete *versus* minute; teeth on the roof of the mouth rather large *versus* small. As a matter of fact such changes are in line with, only much less in degree, than differences *Xenogramma* shows from *Grammatorcynus*.

The proportions of our Peruvian specimen are as follows:—Depth in standard length, 4.5 (est.); head, 3.6. Eye in head, 5.6; snout, 2.5; interorbital, 3.6; maxillary, 2.3; pectoral, 1.8; ventral, 2.4; height of dorsal and anal lobes (center), 2.6; upper caudal lobe, 1.4½; lower caudal lobe, 1.6.

Maxillary to under front of pupil. Gill-rakers obsolete. Tongue broad, free, smooth. A row of sharp, pointed teeth in the jaws, those in the lower jaw and an inner row in the front of the upper jaw of 3 on a side, somewhat larger; a single row of well spaced similar teeth, about as large as, or larger than those on the sides of the upper jaw and about 9 in number, in a curve across the vomer, and on each palatine.

Spinous dorsal weak and low, depressible in a deep slot; anal well behind soft dorsal, its origin under hind rays of same; 6 finlets above and 5 below, the first above scarcely separated from dorsal fin. Uniform small scales over body, their edges covered by smaller to minute scales, and there are also numerous scattered round, dark pores; peduncular keel well developed, wide with a rather thin edge, scaled to the edge.

In preservative the color of head, back and fins is dusky, sides and lower parts only relatively paler. In a photograph of the fish when caught, the sides are paler. Centers of scales tend to be dark with paler borders, suggesting stippling.—J. T. NICHOLS and F. R. LA MONTE, *American Museum of Natural History, New York.*

A TECHNIQUE FOR MEASURING EELS.—Measuring live eels has been a problem for Illinois River fish survey crews for many years. Eels are sometimes taken in hoopnet catches at the rate of half a dozen a day. Struggles of the eels in the course of the measuring process have resulted in 2 to 5 minutes being spent in measuring each one and in noticeable inaccuracies in measurement. Attempts at either stunning or killing the eel in order to measure it are time consuming, and no rapid and effective method for either has been developed.

Recently I found a method of pacifying eels which cuts down considerably the length of time for measuring them and reduces the extent of inaccuracies. First the eel is gently crowded against one side of a sink and held with one hand near its head; then its curves are smoothed out with the other hand by stroking it several times from the head toward the tail. In a moment the eel turns over on its side and is lying straight and relaxed, in which condition it will usually remain for half a minute or more. It is possible that the handling described places the eel in a state of hypnosis.—DONALD F. HANSEN, *Illinois Natural History Survey, Urbana, Illinois.*

FURTHER DATA ON FRESHWATER POPULATIONS OF THE PACIFIC KILLIFISH, *FUNDULUS PARVIPINNIS*.—In a recent note (COPEIA, 1939 (3): 168) *Fundulus parvipinnis* Girard was recorded by the author from fresh water in San Juan Creek, Orange County, California. This record was based on only five individuals, three males and two females, which apparently were stragglers that had ascended the stream from the terminal lagoon following recent heavy rains. In later collections (June 15, 1939, and July 7, 1940) this species was found only in the lagoon which, on July 7, 1940, was cut off from the ocean by a high sand bar. This barrier had been in effect long enough to allow the water to become very nearly fresh throughout most of the lagoon, and only slightly salty to the taste near the lower reaches. The presence of young minnows (*Gila orcuttii*) and growth of water cress (*Nasturtium*) in the upper portion of the lagoon testifies to the freshness of the water at that time, when 566 specimens (young to small adult) of the killifish were obtained. The current from San Juan Creek where it entered the slough was slight, and the temperature of the water was warm (30 to 31° C.). The population of *F. p. parvipinnis* in this lagoon occupies a habitat which has a permanent connection with fresh water and which periodically fluctuates from fresh to brackish water conditions.

Earlier records for *F. parvipinnis* from fresh water in California seem to have been generally overlooked. Eigenmann (1892, Proc. U. S. Nat. Mus., 15: 142) reported the species from Lake Elsinore, Riverside County. It is said to have been extirpated from that lake and no examples are on hand for comparison with other populations of Pacific killifish. Hubbs (1916, Univ. Calif. Publ. Zool., 16: 157) wrote that the species ascends San Gabriel and San Diego rivers to fresh water.

During the spring of 1940, Ralph G. Miller made several collections of Pacific killifish from coastal streams in northwestern Lower California. In the Guadalupe River, about 41 miles south of Tijuana, *F. parvipinnis* was taken in strictly fresh water 1.2 miles east of La Misión bridge (on the highway between Tijuana and Ensenada). This locality is fully 2 miles above the brackish lagoon near the mouth of Guadalupe River and well beyond any tidal effect. The species was abundant at the time of capture: 172 young to adult (including nearly ripe males and females) were taken. The water was clear, the bottom sandy (with occasional gravel), and the temperature in the forenoon was 71.6° F. (air 63.5° F.). At this point the river was 10 to 30 feet wide and 1 to 2 feet deep, and the current was moderately swift. The collection was made on April 15, 1940, and is catalogued as No. 129582 in the University of Michigan Museum of Zoology. No other species were taken.

On comparing this population with the 78 half-grown to adult specimens collected on the same day in the brackish lagoon of Guadalupe River (which is 1 mile west of La Misión bridge and ½ mile east of the ocean), certain differences are evident. The scales and fins exhibit considerable reduction in the amount of mucus covering (which is always thick in brackish water individuals). The nuptial colors of the males (see last paragraph) were much less intense (a feature noted by the collector in the field). Instead of being intense black, the dorsal and anal fins of the males were only weakly pigmented. The sides and back were dusky rather than black and the belly and cheeks showed but a trace of the usual deep yellow. The body is less robust and the average size is smaller: the standard length range for both sexes is 31 to 65 mm., with an average for males of 46.2 and for females of 45.9; the brackish water sample has a size range of 41 to 76 mm., males averaging 63.9 and females 59.9 mm. The San Juan Creek population is similarly much smaller than average brackish water stocks. These differences are attributed to the direct effect of the fresh water environment.

Another collection of *Fundulus parvipinnis* was made in Carmen Creek, 7.6 miles north of Ensenada, from 300 to 440 yards above the ocean. Part of this sample was taken in fresh water over a sandy bottom, from just above the terminal lagoon (but probably not above tidal influence), while the remainder was collected in the brackish water of the lagoon over a bottom of black mud. The collections were not kept separate so that it is not possible to compare them but their general appearance does not exhibit the striking contrasts mentioned above. The Mexicans reported that this species, locally known as "lisa," is found in fewer numbers higher in Carmen Creek (well above tidal influence). How far upstream it occurs was not ascertained, for either Carmen Creek or Guadalupe River.

These Lower Californian populations of *Fundulus parvipinnis* are definitely referable to the subspecies *parvipinnis*. They usually have 34 or 35 scales along the side and are more slender than the extreme southern subspecies, *F. p. brevis*.

The strong tendency of this species to enter fresh water is of interest in connection with the origin of the freshwater species *F. lima* (Vaillant), which occurs at San Ignacio, Lower California. The suggestion by Myers (1930, Proc. Calif. Acad. Sci., 19: 99), that *lima* is a landlocked derivative of *parvipinnis*, is substantiated by the euryhaline tendencies of the coastal ancestor.

In high males of *F. p. parvipinnis* the ctenii on the scales, though strongly developed, scarcely approach the size described by Myers (*loc. cit.*: 97) for *F. lima*. In large nuptial males from Laguna Mugu near Oxnard, Ventura County, the mouth of the Santa Ana River, Orange County, and the mouth of Escondido Creek, San Diego County, the central spine is at most scarcely more than one-half the length of the exposed portion of the scale, and is usually less than one-half that length. The ctenii are best developed along the caudal peduncle where, as in *F. lima*, the central spine attains its greatest size. The dorsal fin is very heavily and rather uniformly tuberculate while the tubercles on the anal fin are most prominent along the posterior rays. The specimens examined ranged from 69 to 86 mm. in standard length and were collected in June and early July, 1940.

The spawning colors of the males in these collections of breeding fish presented a striking contrast of black and yellow. The upper sides and back were jet black, whereas the belly and lower sides (up to about level with the upper edge of the pectoral base) were deep yellow; this color was particularly brilliant on the cheeks and also appeared in reflections between the blackened scales along each side of the body. The base of the caudal peduncle was also yellow. The dorsal and anal fins were intensely blackened, the caudal and pelvics less so; the pectorals were mostly yellowish with some admixture of dark pigment.—Robert R. Miller, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

A "DUMPY" CROAKER, *MICROPOGON UNDULATUS* (LINNAEUS), AND ITS SIGNIFICANCE WITH RESPECT TO RAPID SPECIES CHANGE.—In connection with a survey of marine fishes of Texas in the region of Copano and Aransas bays and the adjacent Gulf of Mexico the writer took 15,590 croakers, *Micropogon undulatus* (Linnaeus), between the dates of March 31, 1941, and August 24, 1942. Aside from fishes with missing tails and parts of the caudal peduncles, which presumably had been bitten off, there were three with malformations involving curvatures of the backbone. One of these was humpbacked. Whether the malformation was caused by the bite of some predator or was inherited is not known, and it is doubtful that this could have been ascertained. The three croakers measured from 8 to 10 centimeters in total length. A fourth specimen, the only adult of the group, differs remarkably from other croakers. It is simply a shortened or dumpy fish. The whole body, exclusive of the head and fins, is greatly shortened. There is no other visible malformation. The shape is very abnormal for a croaker, but is not abnormal for a fish. The specimen was taken in a trammel net on Rattlesnake Point, Copano Bay, Aransas County, Texas, August 6, 1942.

Figure 1 shows the dumpy specimen compared with a normal croaker that was captured with it, which I judged to be of comparable size, since the head lengths were the same. Table I gives comparative measurements of the two specimens. The scale counts along the lateral line of seven croakers taken at the same time ranged from 50 to 60 and averaged 55. The short fish had a scale count of 59. The imbrication of scales was closer than in a normal fish, since the same number of scales lay in a shorter distance. The light, diffuse, horizontal color bars on the back were also closer together than in a normal fish. Likewise the fin ray counts were the same; but the basal lengths of the fins were less than for ordinary fish and the fin rays were closer together. The abdominal space was very much distended by its contents. The backbones of both fish were straight and the vertebral count for each was 23. The vertebrae of the short fish were very much shorter than those of the normal fish.

The significance of this short croaker is problematical. Ordinarily, it is to be expected that this fish and similar descendants, if any, would be weeded out by survival of the

fittest. However, the fish was taken with eight other croakers of about the same size and apparently it was trying with some degree of success to keep up with its fellows and live in the same way. Croakers are bottom feeders. It is doubtful if such a shortened fish could have survived among the plankton feeders, such as *Brevoortia,* that spend more time actively moving. As a croaker, having the habits of croakers it probably had a better chance to survive than would a like specimen of several other species. Croakers are one of the most abundant species of fish in the shallow waters of the northern Gulf of Mexico, as I have shown in previous papers (*see* Relative numbers of shallow water fishes of the northern Gulf of Mexico, with some records of rare fishes from the Texas Coast. The American Midl. Nat. 26, 1941: 194–200); and the Sciaenidae is a successful family with several species of large numbers and diverse habits, that probably are undergoing rapid evolutionary change. If a few short croakers were produced at the same time and a slight change of habits or actions brought about inbreeding, the basis for establishment of a new species would be quickly brought about. Obviously, such chances are very small and the supposition is highly improbable. Nevertheless, it is of some significance that a fish suggesting the possibility is at hand.

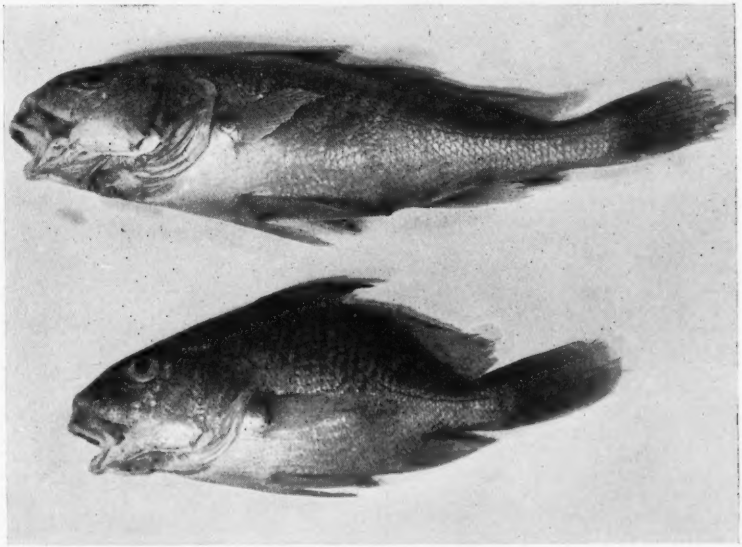


Fig. 1. Normal croaker (above), compared with a "dumpy" specimen

TABLE I. COMPARATIVE MEASUREMENTS OF A SHORT CROAKER AND A NORMAL FISH OF COMPARABLE SIZE.

	Short Croaker	Normal Croaker
Total length	173 mm.	224 mm.
Standard Length	128	178
Head	62	63
Depth	58	53
Fin lengths, longest ray:		
Pectoral	43	44
Pelvic	34	36
Anal	32	33
Caudal	42	43
Caudal peduncle:		
Depth	16	16
Length	15	23
Length dorsal base	69	108
	Lateral line forms rainbow arc in front	Lateral line practically straight

—GORDON GUNTER, *Game, Fish and Oyster Commission, Rockport, Texas.*

PIGMENT DEFICIENCY IN THE CARP AND THE CARP-SUCKER.—Carp completely lacking gold pigment have occasionally been observed in the field collections of the Illinois State Natural History Survey. They are called "chicken" carp by the commercial fishermen of the Illinois River. In the summer of 1942, we observed for the first time a somewhat similar abnormality in the carp-sucker. This is so conspicuous in both species that it is distinguished at a glance, but so far as we know it has not been described.

Of the 3,202 carp, *Cyprinus carpio* Linnaeus, collected in the main channel and adjacent waters of the Illinois River between Ottawa and Grafton in 1942, 18 were recorded as "chicken" carp. These were almost as abundant as the partially scaled "mirror" carp, of which there were 24. The highest percentages of the pigment-deficient type were observed at Browning, Havana, and Meredosia as follows: 5 per cent at Browning (2 out of 39); 2 per cent at Havana (4 out of 193); and 2 per cent at Meredosia (2 out of 100).

The skin of the abnormal ones has a transparent appearance, with a purplish brown body color showing through the scales. One of the conspicuous features of these fish is the wine red color of the gills as seen through the gill covers, which in normal specimens are opaque. This color is visible at other places where a rich blood supply lies close to the surface, especially in the heart region and at the base of the pectoral fins. This pigment abnormality is probably genetic rather than a diseased condition, since these specimens appear plump and otherwise in good health. Furthermore, there were no cases of partial absence of pigment, which could be expected if the abnormality were due to disease. The sizes of the abnormal specimens ranged from 6½ to 19 inches. Specimens smaller than 6½ inches would go through the mesh of the hoopnets which measured one inch.

In the carp-sucker, *Carpiodes carpio* (Rafinesque), the other species of fish to show an absence of pigment, the normal silvery color was totally lacking. The abnormality was found in a single specimen taken September 8, 1942, at Grafton, Illinois. This was the only such specimen among 466 *Carpiodes* taken in 1942 in the Illinois River valley and none has previously been recorded. This fish, in common with the abnormal *Cyprinus carpio,* had a translucent operculum. It was 13.7 inches in length and except for the color difference was like the normal type. Above the lateral line the color of the body was a pale straw yellow overlaid with a black stippling of chromatophores, while below the lateral line the coloring was white with a pinkish cast and a more dilute stippling of chromatophores. The scale rows were well defined, because in the absence of silver pigment the concentrated chromatophores at the scale margins were more visible than in the normal specimens. By actual comparison this color pattern was found to be the same as that of a normal carp-sucker from which the scales had been removed. The scaling process removes from the normal carp-sucker the silver pigment which occurs as an opaque film on the underside of the scales and masks the colors underneath.

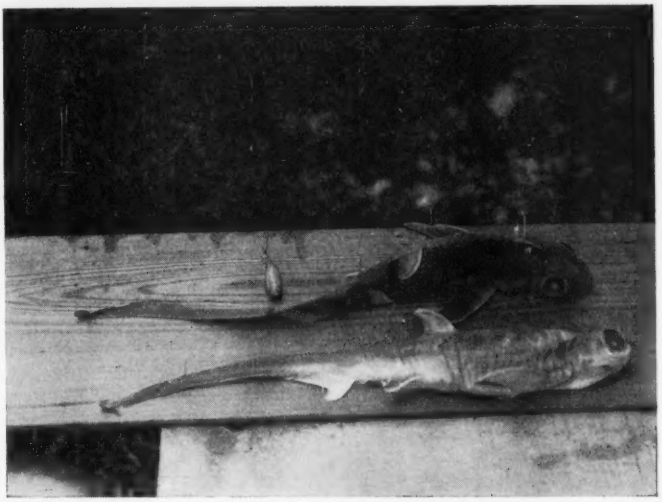
On the other hand, scaling a normal carp does not expose the purplish brown body color which is characteristic of the abnormal carp. It was found that the translucent effect was obtained in the operculum by scraping off the gold pigment from the underside. It may be supposed, therefore, that the transparency of the head region is due to the absence of the gold pigment in the carp and the silver pigment in the carp-sucker.

It was of interest to find that 3 weeks after preservation in formalin, the abnormal carp-sucker had much the same appearance as a normal one, the latter, in the meantime, having lost its silvery sheen.

We are indebted to the other members of the Natural History Survey fishing crew who took part in collecting the data on the frequency of the abnormalities, Dr. David H. Thompson, Mr. Daniel Avery, and Mr. Merlin N. Nelson.—DONALD F. HANSEN and HURST H. SHOEMAKER, *Illinois Natural History Survey, Urbana, Illinois.*

A SECOND SPECIES OF THRESHER SHARK FROM FLORIDA.—A single female *Alopias* with embryos was taken at Salerno, Florida, in August, 1941, and the caudal portion, one eye, two embryos, and an egg from this specimen were saved and presented to me. Unfortunately this material was subsequently lost. The tail length, in known species of *Alopias,* is more or less equal to the body length. The dried and some-

what shrunken tail of the Salerno specimen was about 5 feet 2 inches in length, so a reasonable estimate of the body length of this shark would be a little under 6 feet. The eye of this individual was enormous, the diameter of the exposed colored portion being 3½ inches. In addition to having large eyes, proportionately larger than that of the adult, the embryos show that the first dorsal fin of this form is set far back, its posterior lobe extending over the ventrals. The large eye, in connection with the posterior position of the first dorsal fin, indicates a remarkable similarity in this Florida shark to *Alopias profundus* Nakamura. However, these differences from other species of *Alopias* seem to be more extreme in the Florida shark, so its identification as *Alopias profundus* is questionable.



Embryos from Salerno thresher shark, *Alopias* sp.

Through the courtesy of Mr. William C. Schroeder I was able to examine, as fresh specimens, three small thresher sharks, *Alopias vulpinus* (Bonnaterre), taken at Woods Hole, Massachusetts, in late July, and I have no doubt that these are of the same species as the form usually taken in Florida waters. The second Florida species, represented by the Salerno specimen, is perhaps normally to be found in the deeper water, a distribution which would account for its absence from collections.

Nakamura (1935, Mem. Fac. Sci. Taihoku Imp. Univ. Formosa, 14: 6 pp., 3 pls.) described two thresher sharks from Formosa. One of these, *Alopias pelagicus*, which Nakamura regards as an inhabitant of water of lesser depth, differs chiefly from *A. vulpinus* in having teeth with short recumbent cusps quite unlike the narrow erect tooth cusps of that form. Nakamura's second species, *Alopias profundus*, which he regards as an inhabitant of deeper water, differs from other forms of *Alopias* in having a relatively large eye, and in having the first dorsal fin placed well back. Possibly neither of Nakamura's species is extremely large, the body length of the largest for which he gives measurements being under 6½ feet. Embryos of both forms were obtained, but Nakamura does not identify these as being taken from particular sharks for which measurements are given. It is said that *Alopias vulpinus* attains very large size, perhaps with a body length of as much as 10 feet. In this connection it may be noted that the smallest Woods Hole specimen had a body length of 67 cm. and a total length of 149 cm., and this individual still showed the scar of the attachment of the yolk-sac or yolk-sac placenta.—STEWART SPRINGER, *Shark Industries, Inc., Miami, Florida.*

Herpetological Notes

RANGE EXTENSION FOR *RANA BOYLII BOYLII*.—In a herpetological collection made along the San Gabriel River, San Gabriel Mountains, Los Angeles County, August 11, 1940, I have four specimens of *Rana boylii boylii* and none of *R. b. muscosa*. These four frogs (Stanford Nat. Hist. Mus. Nos. 7225-7228) were taken in the river between the mouth of Cattle Canyon and a point about one mile downstream. Comparison was made with northern specimens of *b. boylii* from Santa Clara Co., Fresno Co. near Coalinga, and from Mendocino Co., and with specimens of *b. muscosa* from Indian Creek, San Jacinto Mts.; Snow Creek, Riverside Co.; Andreas Canyon, Palm Springs; and from the San Bernardino Mts.

My specimens from the San Gabriel River resembled other *boylii* in having a light patch on the top of the head with a darker area crossing the top of the head and the posterior half of the upper eyelids. In three the dorsal ground color is gray with discrete darker blotches. The fourth specimen has a tan ground color with rust colored blotches. The *b. muscosa* examined lacked the contrasting light and dark patches on the head. The dorsal ground color is light with dark brown reticulations. The web in the San Gabriel River specimens is less extensive than that of the *b. muscosa* and closely agrees with that of the *b. boylii*. The San Gabriel specimens are certainly *b. boylii* and not *b. muscosa*. Prof G. S. Myers agrees with me in this subspecific designation.

Previous to this, the southernmost localities of record for *boylii* were San Luis Obispo in the Coast Range and the Kern River near Bodfish. These localities are north of the Tehachapi Mts., where both *b. boylii* and *b. muscosa* are apparently absent (Storer, 1925, Univ. Calif. Publ. Zool., 27: 249). This new locality is south of the Tehachapi Mts. and constitutes a southern extension of range of some 150 miles, well into the supposed range of *b. muscosa*. It is barely possible that this frog has been introduced by some chance into the San Gabriel River.—JOHN C. MARR, *Natural History Museum, Stanford University, California.*

DEFENSE POSTURE OF *VARANUS GOULDII*.—During the melancholy duty of examining the effects left in the late Doctor Glover M. Allen's room in this Museum two photographs appeared. They represent a specimen of *Varanus gouldii* Gray and were taken by Mr. William E. Schevill during the explorations of the Harvard-Australian Expedition under Professor William M. Wheeler in 1931.

This lizard was found at Yandil, which is northwest of Wiluna, western Australia. It is rare that this defense posture is assumed by captive specimens of *Varanus*. They appear to get tame and phlegmatic in captivity in most cases in a short time. I have had good opportunities to observe several species of this genus inhabiting the islands between Java and New Guinea in a wild state. I never, however, saw any of them assume this posture. I recall once approaching the crater lake on the island of Ternate. I was with my wife, two Javanese and a Chinese collector and we approached the water through an open bit of grassland, more or less strung out in line. As we walked along we stirred up more and more specimens of *Varanus indicus* (Daudin) until finally we had a drove of, I should think, as I recall it now, one hundred specimens or more scampering ahead of us, all of which finally took to the water. We preserved a few which are still in this collection.

Neither this species in the Moluccas, which we saw on several occasions, or *V. salvator* (Gray), which is abundant in Java (I saw an enormous one stalking slowly across the lawn of the Governor General's Palace in Buitenzorg), ever stood up in the way indicated in these interesting photographs which seemed to me worthy of being placed on record.

So many travellers concentrate on getting photographs of birds and mammals that good photographs of reptiles from remote localities are relatively rarely seen.—THOMAS BARBOUR, *Museum of Comparative Zoology, Cambridge, Massachusetts.*

Defense posture of *Varanus gouldii*

AN IMPROVED METHOD OF SNAKE FEEDING.—The failure of captive snakes to feed often presents an apparently insuperable obstacle to their successful maintenance.

Although some snakes will feed on living or dead white rats or mice, others will take only the wild species with which they are probably familiar. Many individuals will do neither as long as the food is placed openly in a cage in the usual method of feeding. For these refractory individuals there is a simple and practical device based on the simulation of a natural environmental situation that will usually induce natural and regular feeding, especially on the part of snakes that live mainly upon small rodents.

Pituophis, Lampropeltis, Elaphe, and others forage for warm-blooded prey mainly by entering burrows or other likely rodent homes. The prey is detected through the sense of smell as well as through the ability to see moving objects. When captured in a burrow, the prey is forced to the rear and if it cannot get out via another entrance, it is effectively cornered. If the enclosure is not large enough to permit the snake to coil around its victim, the snake forces as much of its body as possible against the back and sides of the hole and is thus able to crush a small creature. This mode of capture of prey is a natural one.

To simulate natural conditions, a wooden feeding box 3 x 5 x 2 inches is made so that one end is left half open, making an entrance 1½ inches wide and an inch high. A piece of cardboard cut in the shape of a right angle and tacked around the entrance, makes the hole adjustable to the size of the snake's body and keeps the mouse from escaping once the snake has entered. The top of the box may be hinged and provided with a hook. Stunning the mouse before it is placed in the box is advisable. A bit of odorous mouse-nesting material placed about the entrance of the box attracts the snake's attention. After nosing through the nesting material, a snake seems to anticipate the presence of a mouse and enters the hole. It will then often show a high degree of excitement by quick jerks of the head; a sudden lunge follows and the mouse is crushed in the box by as much of the snake's body as can be pulled inside.

A mouse that scared the snake a moment before by running or jumping about openly in the cage, will be attacked by the snake if the mouse be placed in the box and the snake's head inserted through the opening. Lizards may be placed in the box for species that prefer them.

Most snakes learn to associate the box with food and crawl toward it when it is placed in their cage. Once feeding has begun it is not long before the snake will take a freshly killed mouse or rat laid in its cage or held in the hand.

This method of feeding snakes has been successfully carried out with the western species of *Pituophis, Lampropeltis, Coluber, Lichanura, Arizona* and *Rhinocheilus. Crotalus viridis oreganus* and *C. cerastes* have also eaten mice in this fashion, although it is less natural for them to do so. Mice of the genus *Peromyscus* have been used most successfully with the feeding box.—CHARLES H. LOWE, JR., *Biological Laboratories, University of California at Los Angeles, California.*

TWO BROODS OF *EUMECES S. SKILTONIANUS.*—While in the San Bernardino Mountains of southern California, I had the opportunity to observe *Eumeces s. skiltonianus* and note the hatching of eggs of this species. A colony of skinks lived around the shower stall of our camp. During 1940 and 1941 they were observed daily from early June until late August. On July 28, 1940, four minute skinks appeared among the larger individuals. None of these small lizards were present previously. They were observed many times during the days following. On July 29, 1941, four small skinks were again observed running about near the shower, where only larger specimens were present before. They were seen many times afterwards in the immediate vicinity. It is evident that the young skinks hatched out on or shortly before the dates mentioned.

One juvenile was preserved from each of the 1940 and 1941 broods; both are 59 mm. in length and identical in shape, pattern and color.—CHARLES H. LOWE, JR., *Biological Laboratories, University of California at Los Angeles, California.*

HEREPETOLOGICAL NOTES FROM CAMERON PARISH, LOUISIANA.—Cameron Parish is in the southwestern corner of Louisiana, bordering on the Gulf of Mexico. It includes three types of habitat: on the Gulf side there is a narrow strip of sand and shell ridges, locally known as "cheniers," with live oak and palmetto; the

central part consists of extensive coastal fresh and brackish marshes; and the northern boundary is coastal alluvial prairie. The observations recorded here were made principally on the 120,000 acre marsh of the Sabine National Wildlife Refuge and the prairie near Hackberry, Louisiana, during July and August, 1940. An annotated list follows:

Bufo valliceps.—Common on prairie near Hackberry.

Acris crepitans.—Not common.

Hyla cinerea cinerea.—Very common; young abundant in July.

Rana catesbeiana.—Sound records only.

Rana clamitans.—Only one collected.

Rana sphenocephala.—Very common.

Gastrophryne carolinensis.—Very common.

Anolis carolinensis.—On ridges only.

Leiolopisma unicolor.—Common.

Alligator mississippiensis.—Very common.

Lampropeltis getulus holbrookii.—Common; set of seven eggs removed from muskrat house on August 1.

Natrix cyclopion cyclopion.—Very common.

Natrix sipedon confluens.—Not common.

Storeria dekayi.—One collected on marsh bayou ridge.

Thamnophis sauritus proximus.—Very common.

Agkistrodon piscivorous.—Exceedingly abundant along the marsh bayou ridges. Twenty-five were collected in an aggregate of a few hours on six sucessive days, August 12-19. The eight females varied from 56.0 to 87.5 cm. total length. Four were pregnant, the embryos removed varying as follows:

♀ 63.0 cm. — six embryos, 22.1 to 22.4 cm. long;

♀ 64.5 cm. — three embryos, 17.6 to 18.2 cm. long;

♀ 73.5 cm. — two embryos, not recorded;

♀ 87.5 cm. — seven embryos, 25.4 to 26.6 cm. long.

Another female had just eaten two young cottonmouths which were partially digested. Sixteen males varied from 63.5 to 120.0 cm. in length; one 90.5 cm. male had motile sperm in its vas deferens. One 39.0 cm. juvenile was also collected.

Chelydra serpentina serpentina.— Common.

Pseudemys scripta troostii.—Common.

—GEORGE H. PENN, JR., *Louisiana Department of Conservation, New Orleans, Louisiana.*

A FEW REPTILES FROM WESTERN SAMOA.—A small collection of reptiles received by the writer was made from two islands of western Samoa, Upolu and Savaii, by Mr. Floyd Higgins. These specimens are at present in my personal collection. Indebtedness is acknowledged to Karl P. Schmidt, Field Museum of Natural History, for his help in determining many of the specimens. A list of the species follows.

Enygrus australis (Montrouzier).—Two specimens of this species were taken at Falelima, Savaii, November, 1939. One is not now available to me since it was presented to Mr. Ross Hardy, Dixie Junior College, St. George, Utah. The other has a total length of 725 mm., with the tail length approximately 14 per cent of the total length. Ventrals 239, and caudals 59.

Lepidodactylus lugubris (Duméril and Bibron).—Nine specimens from Aleipata, Upolu, July-August, 1938.

Gehyra oceanica (Lesson).—A single specimen from Aleipata, Upolu, August, 1938.

Leiolopisma noctua (Lesson).—Two specimens from Aleipata, Upolu, August, 1938.

Emoia cyanura (Lesson).—Two specimens from Aleipata, Upolu, August, 1938.

Emoia nigra (Hombron and Guichenot).—A single specimen from Aleipata, Upolu, August, 1938.

Emoia murphyi Burt.—One specimen from Falelima, Savaii, November, 1939.

Emoia adspersa (Steindachner).—A single specimen from Falelima, Savaii, November, 1939.

Emoia samoensis (Duméril).—One specimen taken at Aleipata, Upolu, August, 1938.

—HAROLD HIGGINS, *University of Utah, Salt Lake City, Utah.*

Reviews and Comments

FISHES OF WESTERN SOUTH AMERICA. I. THE INTERCORDILLERAN AND AMAZONIAN LOWLANDS OF PERU. II. THE HIGH PAMPAS OF PERU, BOLIVIA, AND NORTHERN CHILE. WITH A REVISION OF THE PERUVIAN GYMNOTIDAE AND OF THE GENUS *ORESTIAS*. By Carl H. Eigenmann and William Ray Allen. 4 to., xvi + 494 pp., 48 text-figs., 22 pls., 1 map. University of Kentucky, Lexington, Kentucky. 1942.[1]—Like a phoenix, this book arises from the ashes of the great school of South American ichthyology built by Eigenmann and destroyed by the events connected with his tragic death in 1927. The junior author had left Bloomington; the manuscript was lost by Dr. Eigenmann during his last illness and was discovered only by chance, after his death, in a railroad lost-and-found room; and the Indiana fish collections were sold and removed (out of reach of the junior author) to California, where they are even yet not in sufficiently good order for careful study. Through all these discouragements, Dr. Allen carried on and brought the work to completion. Now, through the munificence of the University of Kentucky, the book has been published in a style befitting its importance. South American ichthyology owes a debt of gratitude to William Ray Allen.

This splendid volume rounds out the picture of the fish faunas associated with the Cordillera presented in Eigenmann's "Fresh-water fishes of Northwestern South America" (1922), Pearson's "Fishes of the Rio Beni Basin" (1924), and Eigenmann's "Fresh-water fishes of Chile" (1927). As in those papers, there is a careful consideration of the geographical, physiographic, and hydrographic background, extensive comparative lists of the species of various basins, and a discussion of the relationships of the faunae. There is a gazetteer and a map, a narrative of the explorations upon which the fishes were collected, and an extensive bibliography. One can but compare this work with some of the other recent bulky reports on collections from the same general region—reports made in a sort of perpetual ichthyological rolling-mill (the fish go in here and the papers come out there), with such a huge number of needless errors as to make use of the publications more time consuming than their production.

Two especial features of the volume deserve commendation. The first is the fine account of fishing methods (both native and ichthyological) and of the commercial fisheries of the area. Dr. Allen has done great service in presenting these data, a subject to which no writer on the region has given attention. The second is the space given to the use of *cubé* root in fishery. The authors were the ones who introduced this valuable product to scientific knowledge. The wide use of *cubé* as a commercial agricultural insecticide (especially now that the supply of the East Indian *Derris* is cut off) attests to the unexpected wide extra-ichthyological value of at least one fish-collecting expedition.

There is neither room nor reason to discuss at length the systematic part of the paper, but one or two unfortunate nomenclatural and other matters should be noted by users of the book. The substitution of *Cichlaurus* for *Cichlasoma* is deplored by the reviewer; the International Rules seem to give no support to the change. *Canthopomus* is described as a new genus apparently without knowledge of certain provisions of the International Rules or of the fact that it was actually defined (in a footnote) in Eigenmann's 1910 *Catalogue*. The use of *Hypostomus* for *Plecostomus*, though followed for a while by the reviewer and others, has been found untenable by Dr. Gosline. In what was evidently a late revision of the manuscript, Dr. Allen has attempted to modify the arrangement of the characins in accordance with Gregory and Conrad's recent paper on this group. The result is not happy; closely related forms are widely separated. While the reviewer is perfectly aware of the improvements in characin classification effected by Gregory and Conrad, he also feels that a more extensive acquaintance with the group on the part of

[1] Copy received by library of Museu Nacional, Rio de Janeiro, August 25, 1942.

those authors would have shown them how untenable are a number of their conclusions. They examined only a very small proportion of the genera and any attempt to fit numerous South American genera into their system, on an osteological or any other basis, results only in chaos. One cannot (as they have tried to do) work out the "phylogeny" of large fish groups on plainly insufficient materials and a shuffling of a set of outline drawings. Finally, Dr. Allen, in puzzling over the evolutionary radiation of *Orestias* in Lake Titicaca, has evidently missed some of the literature on the ecological and genetic aspects of the radiative evolution of fishes in great lakes to which fishes in general have had limited access. Herre has discussed this interesting problem in connection with Lake Lanao, and the reviewer—and more recently Worthington—in relation to the great lakes of Central Africa.—GEORGE S. MYERS, *Museu Nacional, Rio de Janeiro, Brazil.*

BIOLOGICAL SYMPOSIA, edited by Jaques Cattell; the Jaques Cattell Press, Lancaster, Pa.—

Volume II: Speciation; Defense Mechanisms in Plants and Animals; Biological Basis of Social Problems; Regeneration. 1941: 270 pp.

Volume IV: Population Problems in Protozoa; Experimental Control of Development and Differentiation; Theoretical and Practical Aspects of Polyploidy in Crop Plants; The Species Concept. 1941: 293 pp., illustrated.

Volume VI: Temperature and Evolution; Isolating Mechanisms; Genetic Control of Embryonic Development. 1942: 355 pp., illustrated.

Volume VII: Visual Mechanisms. 1942: 322 pp., illustrated.

Volume VIII: Levels of Integration in Biological and Social Systems. 1942: 240 pp., illustrated.

Biologists have had to adopt the "divide and conquer" technique for expediting research in biological phenomena. The subject is much too broad to master as a whole, so it has been subdivided into a number of convenient niches which are, in turn, subdivided ad infinitum. Although such specialization is necessary, some of the disadvantages accompanying it are not. There has been too little emphasis on integration, not enough attention given to coordinating techniques even within a limited field. Perspective of the whole has been lost by a too exclusive preoccupation with a chosen fragment.

The symposium is being employed by workers in biology as one means of doing something about this lack of integration within the "niches" of biology. A well planned symposium brings together many of the authorities working in a particular field of research and gives an opportunity for summarizing the research being conducted in the field, and of analyzing its significance, as well as its relationship to other phases of biology. As the themes chosen for symposium treatment generally concern a major biological process or problem, the results are not only of interest to workers within the field under discussion, but to most biologists. The symposium is thus a partial answer to the crying need for synthesis. However, the value of a symposium is bound to be limited unless its contributions can be published as a unit; consequently, we must welcome warmly the appearance of a series of volumes devoted exclusively to publishing outstanding "Biological Symposia."

Eight volumes of "Biological Symposia" containing twenty-one separate symposia have already appeared during 1941 and 1942 under the editorship of Jaques Cattell.

In the limited space of this review it will not be possible to discuss each; hence, I will confine my remarks to a few of the symposia that should be of general interest to readers of this journal. The problem of speciation is one of those controversial subjects happily suited to the symposium method, which can do much to clarify the problem. Twelve articles on the subject are contained in volumes II and IV, dealing with speciation in such diverse groups as mice (*Peromyscus*), birds, fish, insects, snails, and plants. The article on "Speciation in Fishes" is by Carl Hubbs, who crystallized his discussion about his diverse studies in fish taxonomy and hybridization, using the viewpoint of a naturalist. The other articles present the problem of speciation from as many diverse viewpoints and techniques as there are articles. An interesting approach is that of M. R. Irwin and R. W. Crumley, who use immunological procedures and antigens in studying species and their interrelationships in doves and pigeons. Rather startling is the contention of J. L. Baily that natural selection is chiefly physiological. Dr. Ernst Mayr condenses a gen-

eralized picture of the evolution of speciation in birds into a simplified outline consisting of five stages. A stimulating discussion is that of T. Dobzhansky in an article entitled "Speciation as a Stage in Evolutionary Divergence."

The symposium on "Defense Mechanisms in Plants and Animals" discusses the methods developed by plants and animals to fend off or neutralize parasitic attack. This is an interesting field that is inadequately covered by the three articles. The article by William Bloom on "Local and Generalized Defense Reactions in Animals," tracing the sequence of reactions of an animal to local inflammation, deals with a subject of general interest to all biologists.

The problem of "Temperature and Evolution" is presented in a well-coordinated symposium of eight contributions. Temperature affects living organisms in a number of ways that might result in intraspecific divergence or micro-evolution. One effect of extremes of temperature is to induce polyploidy. G. Fankhauser discusses such polyploids in salamanders. However, polyploidy is of questionable importance in actual species formation. Temperature is known to increase the mutation rate and this relationship may be of more significance in species formation; it probably accounts for the greater number of species in tropical areas. John Moore concludes from his investigations of the rôle of temperature in speciation in frogs that it is important as a selector of mutations, not as a producer of such changes. Temperature may effect the developmental processes in unexpected ways: E. Witschi discusses the effect of temperature on the differentiation of sex glands in amphibia where low temperatures favor female differentiation, while high temperatures favor the opposite sex.

Volume VII, dealing with "Visual Mechanisms," shows an advance over some of the earlier symposia in that it deals with the subject more thoroughly. Eight of the articles were given at a symposium on "Visual Mechanism" held at the University of Chicago in 1941, while four additional articles were solicited to make the volume more comprehensive. Visual mechanisms are dealt with from such diverse viewpoints as the physical, biochemical, physiological, morphological, and psychological. The advances being made in the field of vision will amaze many readers of this volume. Of unusual interest should be two of the solicited articles. George Wald, in an article entitled "Visual Systems and the Vitamine A," discusses his interesting discovery that fresh water fish have a different photosensitive pigment in the rods than marine fishes and other vertebrates. He calls the photo-pigment of fresh water fishes porphyropsin, while marine fishes have the usual rhodopsin, euryhaline fishes a mixture of both. Gordon Walls, in a discussion of "Visual Cells and their History," uses the types of rods and cones present in vertebrate retinae as a basis for tracing evolutionary relationships. Much of the discussion in this paper concerns visual cells in fish and reptiles, and the article contains a number of excellent illustrations of visual cell types in these groups as well as in other vertebrates.

Another symposium with wide appeal appears in volume VIII under the title "Levels of Integration in Biological and Social Systems." Several of the articles deal with organismic integration at levels ranging from the most primitive protozoan colony to the advanced vertebrate organism. Of course the emphasis placed on the development of the nervous system in higher animals makes the transition of emphasis in the latter articles from the individual to society seem a natural one. Then, too, social differentiation follows a pattern which is suggestively similar in some respects to the organismic integration traced in the animal groups. Group organization is not only traced in insects and among many vertebrates but even in its primitive manifestations among infusoria. Biologists who are not acquainted with the work of H. S. Jennings on social manifestations in *Paramecium* should acquaint themselves with this interesting research. It is summarized by Jennings in an article entitled "The Transition from the Individual to the Social Level." The sequence of the articles on society gradually builds up to modern human society as the apex. Light is thrown on the evolution of human society by articles on the societies of monkeys and apes and of primitive man.

A bibliography of pertinent literature is appended to most of the articles appearing in the above volumes. The value of the symposia would be somewhat enhanced if every article were required to have such a literature list, since bibliographies are a decided aid to biologists wishing to gain additional information on a particular subject.—ELBERT H. AHLSTROM, *Stanford University, California.*

REPORT ON THE FISH AND FISHERIES OF LAKE NYASA. By C. K. Ricards Bertram, H. J. H. Borley and Ethelwynn Trewavas. Published on behalf of the governments of Nyasaland by the Crown Agents for the Colonies. London, 1942: 1–179, 15 figs.—This is a report on the survey conducted in 1938 by Dr. B. S. Platt to investigate the state of nutrition of the native population of Nyasaland. Aims of the study were to determine the role of fish in the native economy, to measure the abundance of the fish stock, and to discover how exploitation of the stock might be increased, in accordance with conservation principles, by improving fishing methods and by stocking. Descriptions and keys to the various species of fishes are given; methods of capture described, and the procedure of studying biology, abundance and possible new methods of utilization recounted. Because of the war, the study was discontinued at the end of one year. Nevertheless, a remarkable quantity of good, useful information was obtained, and it is hoped that the work will be continued when peace is restored.—L. A. WALFORD, *Jordan Hall, Stanford University, California.*

THE VERTEBRATE EYE AND ITS ADAPTIVE RADIATION. By Gordon Lynn Walls. The Cranbrook Institute of Science (Bulletin No. 19), Bloomfield Hills, Michigan, 1942: iii-xiv, 1-785, frontispiece, 197 figures, I plate, XI tables. $6.50.—On the reverse side of the last page of this Cyclopean book there is the following statement by the Cranbrook Institute of Science: "The bulletins, of which this is No. 19, each present some subject of natural science in a manner authoritative, yet non-technical. They are intended to be of value to the interested layman and to the specialist alike."

Dr. Gordon Lynn Walls, Research Associate in Ophthalmology at Wayne University College of Medicine, has, in this reviewer's opinion, done a remarkable job in handling such a complicated and intricate subject as the vertebrate eye and all its multiple ramifications in a manner that fulfills the tenets cited above. As stated in the Preface, "This book will be of particular benefit to zoölogists and ecologists, medical and veterinary ophthalmologists, and comparative psychologists." It should "— be entirely clear to any college student or graduate, and to any amateur naturalist—'trained' or not." Both the author and the Cranbrook Institute of Science are to be congratulated on producing such a monumental contribution — a work which is, on the whole, well organized and presented, abundantly and beautifully illustrated, and full of fascinating information on a subject which has wide appeal and interest.

The Vertebrate Eye is divided into three main parts. The first of these (BASIC) contains a generalized background to the subject, starting with light and its perception, giving straight-forward accounts of the structure of the human eye and the retina, discussing the visual process, and including some material on the genesis of the eye and the elements of vertebrate phylogeny. The casual zoölogist who happens to open this book at the last-mentioned subject will almost unquestionably be amazed at the elementary nature and simplicity of the treatment. And the ophthalmologist will almost equally certainly have a similar reaction to other parts of this section of the book. But if both of these individuals will read through the whole of Part I, they will indubitably add to their knowledge. Indeed, this generalization applies even more aptly to the entire book. The embryologist is doomed to disappointment if he expects to get much information from Chapter 5; this is clearly a weak discussion, and in fact, the present reviewer was distressed by the almost total neglect of the embryological aspects and implications of the subject matter of *The Vertebrate Eye*. Yet the embryologist who tackles the whole book cannot fail to benefit from it, and it is hardly fair for the specialist to be too critical of "his" particular section when one considers the aims of the author and his publishers as well as the wealth of information that is contained between the two covers of this tome.

Part II is called ECOLOGIC. It deals with the adaptations of the vertebrate eye to arythmic, diurnal, and nocturnal activity, and to space and motion, media and substrates, and photic quality. This is the largest of the three sections, and is in essence the meat of the book. In no other single place can one find an even vaguely comparable amount of information on the subject. Dr. Walls' knowledge of and researches in this field are at once apparent, and no one can fail to appreciate the content of these 400 pages. The subject of accommodation is especially well treated and will be welcomed by many as an

easily available, comprehensive treatment of a hitherto relatively inaccessible and difficult topic. The discussion of the eyes of cave fishes in Chapter 11 is disappointingly brief and suffers from the fact that it does not include the work of Breder and Gresser on the *Anoptichthys-Astyanax* series from Mexico, since this is by all odds the most interesting study of its kind which has appeared in many years. This, however, is not oversight on the author's part, but is instead due to the fact that the above-mentioned research is so recent as nearly to coincide with the completion of *The Vertebrate Eye.*

Part III (SYNOPTIC) is phylogenetic in its approach. The eye as a whole and the retina in particular are successively treated in the main vertebrate groups. Chapter 16, on the reptiles, is of exceptional interest, and the Ophidian eye, to which Dr. Walls has devoted much time and study, is highly stimulating. This part of the book should be valuable as a source of easy reference to the eye-structure of any vertebrate group. But it should at the same time be pointed out that the text as a whole "—is not designed as a reference book, in which to 'look up' small points from time to time." For some it will be a disappointment not to find the book thoroughly documented, and to discover the names of investigators in this field in the text which are not cited in the bibliography. However, there are nearly 500 carefully selected references, with stars marking the major works. There is also an extraordinary list of workers on pp. 718-719, "—most of them still living and active, who have been particularly productive in the field of this book in recent years or are likely to be especially productive in the future." According to Walls, "Not all of these investigators are wholly 'trustworthy'—two or three are decidedly not, but are included here because they are too prolific to be ignored."

There are a number of things about *The Vertebrate Eye* that will undoubtedly come in for adverse comment. Dr. Walls' teleological approach, although explained in the Preface, will bother some readers; the fact that the book is inevitably repetitious in parts may annoy others; the style and phraseology may leave something to be desired in the opinion of certain critics; and the combined Index and Glossary, which is perhaps over-complicated and not by any stretch of the imagination a collection of explanations of words, will not satisfy some who use this book.

Grant these criticisms and possibly others. The fact still remains that this is an outstanding volume. It will be of value to many and of interest to all. It fills an enormous gap and will not easily or soon be supplanted. It is a great credit to its author, editor, the curators of the Museum of Zoölogy of the University of Michigan, and the others who have assisted in its production.—DANIEL MERRIMAN, *Bingham Oceanographic and Osborn Zoological Laboratories, Yale University, New Haven, Connecticut.*

THE SALAMANDERS OF NEW YORK. By Sherman C. Bishop. Bull. N Y. State Mus., 324, 1941: 1–365, fig. 1–66.—Those of Dr. Bishop's friends and colleagues who have seen the superb water-color paintings of the salamanders of eastern North America accumulating under his supervision over many years will have felt some regret at the appearance of his "Salamanders of New York" without colored illustration. The work was planned to form one of the quarto series descriptive of the New York fauna; it has now appeared in the octavo bulletin of the New York State Museum, with black and white reproductions of the colored plates.

The failure of the project for colored plate illustration, with the various delays in publication involved, has had the compensatory result that the author has had some twenty years in which to prepare and add to his text, much of which is based on extensive personal observation and research. The work as a whole forms an extraordinarily satisfactory account of a rich and varied section of the North American salamander fauna, which is represented in New York State by seventeen species belonging to ten genera. These are discussed in a uniform treatment, with separate sections for descriptive matter, activities of the breeding season, development, habits, habitat, remarks, distribution, and a condensed bibliography, each broken into subordinate headings so that all of the information is readily findable.

Thus the naturalists of the northeastern states, whether amateur or professional, are provided with a handbook to one of the most interesting groups of animals, whose

further more severely biological interest is attested by the vast structure of experimental research based upon some of the more familiar species. The introductory section provides keys for the identification of various life history stages as well as of adults. One might think from the work of some taxonomists that animals exist mainly to be described and identified. It is gratifying to find this section, though given its proper place and emphasis, supplemented by a very complete resumé of all that is known about the breeding habits, development, and habits in general. These sections are especially well illustrated with halftones from photographs. The distribution maps are well prepared and well documented "spot maps" and the only objection that can be raised against them is their strict limitation to a state framework.

The plates are marred by failure of the editorial office and printer to eliminate the lines between the separate figures. Otherwise the black and white reproductions of the paintings will be disappointing only to those who had hoped to see them in color. While it must be admitted that colored illustration is of primary importance in the colorful salamander group, it is evident that a great expansion of the interest in natural history must take place before we can hope for illustrations in color of cold-blooded land vertebrates to compare with those already available for birds, mammals, and fishes.—KARL P. SCHMIDT, *Field Museum of Natural History, Chicago, Illinois.*

THE RING-NECK SNAKES, GENUS DIADOPHIS. By Frank N. Blanchard. Bull. Chicago Acad. Sci., Vol. 7, pp. 1-144, 26 text figures, 4 maps, 17 tables.—This work has a special significance for American herpetologists because during a period of many years the late Frank N. Blanchard was the leading student of American snake taxonomy and life histories. His two decades of publication cover the adolescent stage of ophiological studies in the United States and this, his final monograph, is the corner stone on which the mature structure of snake taxonomy may securely rest. That Dr. Blanchard not only led his special field but grew along with it, becomes evident when one compares his 1921 *Revision of the King Snakes* with the present volume.

Although an untimely death cut the work on ring-neck snakes short of completion, it had gone far enough to allow Dr. Howard K. Gloyd to finish it. This is highly appropriate since Dr. Gloyd, one of Blanchard's older students, had begun with him an extensive monograph of American snakes. Gloyd feels sure that a general introductory section to the ring-neck investigation had been prepared, but diligent search has failed to bring it to light. This lost section contains Blanchard's mature reflections on the speciation and distribution of North American snakes and was expectantly awaited by all herpetologists.

The present monograph begins with Dr. Gloyd's brief foreword. This is followed by a description of the genus. Each form is then taken up separately and, following a full synonymy, treated under these heads: description, habits, habitat, distribution, material examined, variation, and affinities. The second and third, like the last two, are usually combined. Good line drawings of dorsal, lateral, and ventral views of head and neck are given for all but three forms, and histograms show the distribution by size and sex of ten. Other graphic presentations appear and numerous tables summarize dental and scale characters and measurements. Ranges are clearly shown on four spot maps. The treatment of each group ends with a discussion of affinities and a diagram illustrating them. The monograph terminates with a brief general summary of intrageneric relationships.

The genus proves to be a natural assemblage divisible into four groups without overlapping ranges. The most primitive species inhabits central Mexico and has a more southern distribution than any of the other 14 forms. *Diadophis* is another genus of North American snakes that differentiated from a southwestern center.

Not the least pleasing features of this volume are its excellent organization, admirable standardization of treatment, and clear, simple diction. No trace of scientific jargon or *copia verborum* can be detected. The typography and format are also excellent. Unfortunately, the illustrations are not listed. The bibliography and index are adequate and a list of the errors, all of them minor, faces the first page of the index.—CLIFFORD H. POPE, *Field Museum of Natural History, Chicago, Illinois.*

ANFIBIOS E RÉPTEIS DO BRASIL (VIDA E COSTUMES). By Enrico Santos. 8vo. 280 pp., 57 text-figs., 9 colored pls. F. Briguet and Cia., Rua do Ouvidor 109, Rio de Janeiro, Brasil. 1942.—The author of this volume, who has done books on the fruits and birds of Brazil, and is now considering doing the mammals, has produced the first general semi-popular work on the herpetology of the country, and as such it deserves notice in COPEIA. Mr. Santos occasionally lapses into poetry, and each chapter opens with a quotation from Homer, Lucretius, or Curran and Kauffeld, but the book manages to pack a considerable amount of information into its pages. One valuable feature, all too rare in books published in Brazil (where few give credit to other current workers in their own field), is a bibliography of herpetological books and papers. But this bibliography points out in startling fashion the greatest Brazilian handicap to zoology—lack of well stocked libraries. Foreign books are far too expensive for individuals to buy them, good zoological libraries can be counted on the fingers of one hand, and even the best of these are very incomplete. The author has seen all of Amaral's reptile papers except those published outside Brazil, and all of Miranda-Ribeiro's frog papers, though but one of those of Adolpho Lutz. Of European papers, he has seen three French and one Spanish paper, all unimportant, and of North American herpetological publications only the books of Ditmars, of Curran and Kauffeld, and one article of Miss Cochran's. The result can be imagined. The colored plates and some of the text-figures are not bad (though one notices some similarities to other well-known figures). The first text illustration shows two figures of a skipper goby (labelled a Crossopterygian) attempting to become an amphibian.—GEORGE S. MYERS, *Museu Nacional, Rio de Janeiro, Brazil.*

EDITORIAL NOTES AND NEWS

Annual Meetings

A QUESTIONNAIRE was sent out by the SECRETARY last autumn to the Board of Governors and to the officers of the Society, asking for opinions as to the advisability of postponing the 1943 meetings. The majority of replies indicated the desire of the members to leave the matter entirely in the hands of the elected officers. Subsequently a copy of a letter from JOSEPH B. EASTMAN, Director of the Office of Defense Transporation, requesting cancellation of scientific meetings in 1943, was received from the National Research Council. The officers have agreed that the annual meeting should be postponed until the war is over or until transportation facilities improve.

Before planning the 1943 annual meeting of the WESTERN DIVISION of the Society at Corvallis, Oregon, the officers sent a questionnaire to 123 members of this group, and replies were received from 58. Of these, 81 per cent favored no meeting, 9 per cent thought the meeting should be held, and 10 per cent were undecided. Because a great majority thought the meeting should not be attempted, and because only a small number could attend, all plans for a June meeting have been cancelled. The members were also asked their attitude about postponing further meetings until after the war—76 per cent favored such postponement, 10 per cent opposed, and 14 per cent were undecided. This question will be held open until 1944, when, if transportation problems are not so acute, a meeting may be feasible.—FRANCES N. CLARK, *Secretary protem, Western Division.*

Members in U. S. Service

THE editors have been endeavoring to keep a complete file of the members of the Society in the armed services, with their addresses, and they will appreciate receiving additions and corrections to the incomplete list which follows. We regret that space will not permit the listing of the many and valuable war services which are being carried on by our civilian members. A starred name indicates overseas service.

*Atz, Sgt. James W., U. S. Army.

*Bailey, Cpl. Joseph, Army Air Force; Beckman, Sgt. Wm. C., Army Medical Corps; Blair, Lt. Albert P., Army Air Force; Brown, Cpl. Bryce C., Army Medical Corps; Burton, George W., Army Air Force.

Calhoun, Pharm. Mate Alexander J., U. S. Navy; Cassell, Lt. Robert T., Army Medical Corps; Clanton, Cpl. Wesley, Army Medical Corps; Crocker, Lt. Richard S., Army Air Force.

Davis, D. Dwight, Army Medical Corps; Davis, John, Army Medical Corps.

Fitch, Henry S., Army Medical Corps; Flury, Alvin, Army Air Force.

Gilman, Page, U. S. Army; Glass, Lt. Bryan P., Army Air Force; Goldstein, Robert C., Army Medical Corps.

Hamilton, Capt. W. J., Jr., Army Sanitary Corps; *Hammett, Sgt. James W., Jr., U. S. Army; Hassler, Wm. G.; *Hawken, John C., prisoner on Bataan; Hubbs, Clark, U. S. Army.

*Johnson, Lt. Raymond E., U. S. Marine Corps.

Kauffeld, Carl F.; Keegan, Hugh L., Army Medical Corps.

Lachner, Ernest A., Army Air Corps; Leonard, Lt. Justin W., Army Sanitary Corps; Levy, Cpl. Stanley, Army Medical Corps.

Mansueti, R., Army Medical Corps; Manville, Cpl. Richard H., Army Medical Corps; McFarland, Ensign Robert W., U. S. Navy; Mottley, C. McC., U. S. Navy.

Obrecht, Cpl. C. B., U. S. Army.

Parker, Sgt. Malcolm V., Army Medical Corps; Penn, Ph. Mate George H., Jr., U. S. Navy; Peters, James A., Army Air Force.

Raney, Lt. E. C., U. S. Navy; Rodman, Gage B., Jr., Army Air Force; Ryan, Sgt. George F., U. S. Army.

Shreve, Benjamin, U. S. Army; Simon, Lt. James R., U. S. Navy; Smith, Cadet Albert, U. S. Navy; Snyder, Cadet Richard C., U. S. Navy; Soulen, Lt. G. H., U. S. Army.

Trapido, Harold, Army Medical Corps.

Walker, Lt. Boyd, U. S. Army; Walker, Charles F., Army Medical Corps; Werler, John, U. S. Coast Guard; *White, Sgt. Theodore E., Army Air Force; Wood, Lt. Sherwin F., Navy Medical Corps.

News Notes

DR. William Alonzo Gosline, III, has resumed his research on South American fresh water fishes at the Stanford University Natural History Museum. He returned in January from a fourteen-month service in the Near East with an ambulance unit of the American Field Service. He was stationed in Syria and Egypt and made good use of his limited opportunities to study the flora and fauna. He has presented to the Natural History Museum a small but valuable collection made in Syria.

Dr. George S. Myers, at the Museu Nacional, Rio de Janeiro, Brazil, is presenting a course on fisheries methods. He is continuing his research at the Museu, and making field studies and collections in various river systems of Brazil.

Wilbert M. Chapman, of the Department of Fisheries, State of Washington, and past President of the Western Division of the Society, has taken up his duties as Curator of Ichthyology and of the Steinhardt Aquarium at the California Academy of Sciences, San Francisco. Since the death of H. Walton Clark, more than a year ago, V. R. Slevin, herpetologist of the Academy, has served as acting Curator of this division.

DR. CHARLES M. BREDER, JR., of the New York Zoological Society, has returned from a trip to Ecuador.

After certain Divisions of the U. S. Fish and Wildlife Service moved to Chicago, ISAAC GINSBURG was assigned to the old Biological Survey field station in Maryland. S. F. HILDEBRAND is stationed at the U. S. National Museum.

KARL P. SCHMIDT has been appointed Lecturer in Zoology in the University of Chicago.

ALFRED PERLMUTTER, of the Fish and Wildlife Service, has recently been placed in charge of the rosefish investigation. The rosefish fishery has risen from one of little significance in 1935 to second place along the Atlantic Coast. The 1941 yield was more than 126,000,000 pounds.

It is reported that Life Member PROF. J. LINDSLEY GRESSIT, recently of Lingnan University, Hong Kong, is in the hands of the Japanese in an internment camp.

Recent Deaths

DR. C. TATE REGAN, Keeper of Zoology in the British Museum (Natural History), and an Honorary Member of our Society, died on January 13. Dr. Regan was one of the outstanding living authorities on systematic ichthyology and the phylogeny of the lower vertebrates and had been recently engaged in work on the Acanthodii.

DR. LOUIS ROULE, formerly Professor of Science at the Paris Museum of Natural History, has died at the age of 89. Dr. Roule is well known for his contributions to ichthyology and fisheries research, and as author of a series of popular books on the life ways of fishes.

DR. E. J. ALLEN, long Director of the Plymouth Laboratory and a contributor to fisheries biology, died on December 7, aged 76.

DR. HOWARD A. KELLY, world famous surgeon, died January 12, at the age of 84. Dr. Kelly was best known as a member of the celebrated "Big Four," of Johns Hopkins University, the group which formed the nucleus of the staff of the hospital when it was founded in 1889. Dr. Kelly retired from the teaching staff of Johns Hopkins in 1919, serving as consultant since that year. His keen interest in nature led him to extensive studies in fungi and reptiles. To many young herpetological students Dr. Kelly was a kindly and sympathetic friend, and had aided many of them with advice and other needed assistance.

DR. JOHN FRANKLIN DANIEL, Professor of Zoology at the University of California, and widely known for his researches on the comparative anatomy of the Elasmobranchii, died in Berkeley on November 2, aged 69.

Report from the Treasurer

THE TREASURER advises, "for the sake of the record," that he has purchased, for the Endowment Fund of the Society, a United States Savings Bond, Series G, of the denomination of $1000, issued as of the first day of December, 1942, and due 12 years from this date. Interest at the rate of 2½ per cent is payable semi-annually. This bond bears number M 1197030 G, and is issued in the name of the Society, with the additional annotation, "An unincorporated association." The address of the Society is given as "Carnegie Museum, Pittsburgh, Pa."

Aid to Copeia

FINANCIAL assistance in printing the plates in this issue of COPEIA has been received from the SPECIAL GIFT FUND of the Society, from the WYOMING GAME AND FISH COMMISSION, from the ASSOCIATED FISHING TACKLE MANUFACTURER'S TRUST FUND for Fisheries Research in the University of Michigan, and from DR. THOMAS BARBOUR.

COPEIA IS THE JOURNAL OF THE AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS

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Original contributions, not to be published elsewhere, are alone acceptable.

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Figures, author's corrections, expensive tabular matter and unusually long articles may be charged in whole or in part to the author, at the discretion of the Editors.


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